

107E-5556-JWH
6 May 2004



Mr. Patrick Quinn
Missouri Department of Natural Resources
Hazardous Waste Program
1738 East Elm Street
Jefferson City, Missouri 63101

RE: Comments concerning the Enhanced Bioremediation Pilot Test Report for the McDonnell Douglas Tract I Facility, Hazelwood, Missouri, Permit # MOD000818963

Encl: Revised Enhanced Bioremediation Pilot Test Report for McDonnell Douglas Tract I, Hazelwood, Missouri

Dear Mr. Quinn;

Following is our response to your April 21, 2004 comment letter on the Enhanced Bioremediation Pilot Test Report for the McDonnell Douglas Tract I Facility.

Specific Comment 1.

As discussed during our March 19, 2004 meeting, the reference to two pounds per foot is a typographical error. Six pounds per foot of HRC was used in each boring, for a total of 810 pounds in the nine borings. The report text has been corrected.

Specific Comment 2.

The amount of water released by the fire line, which is owned by GKN, is not known. An increase in dissolved oxygen was noted in the pilot test wells immediately following the release and at the subsequent sampling, 30 days after the release. The dissolved oxygen levels returned to the favorably low levels in the sampling conducted 60 days after the break. It is possible that this increase in dissolved oxygen may have temporarily slowed the rate of reductive dechlorination; however, it did not appear to have any long-term effect on the pilot test. A discussion of this has been added to the conclusions of the report.

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Specific Comment 3.

DCE concentrations in MW-3 were reduced by 21 percent at the end of the pilot test and by 95 percent in MW-3B. DCE created by the dechlorination of TCE will be exactly the same as the DCE present in the groundwater before the start of the pilot test and would not be preferentially degraded. In fact, the cis-DCE present before the start of the pilot test was almost certainly the result of natural dechlorination of TCE, since cis-DCE is not a constituent commonly found in commercial or industrial products and is not known to have been used at the facility. Vinyl chloride concentrations increased for the first half of the pilot test and then were observed to decline. Based on the data collected, the decline in vinyl chloride concentrations is expected to continue.

The data clearly indicate that dechlorination of all chlorinated compounds, including DCE and vinyl chloride, occurred (for example, detection of ethane/ethane at the same time vinyl chloride concentrations declined). The report clearly presented this data, for example, clear trends for reduction of DCE and vinyl chloride can be observed in Figure 5-1. The conclusion section of the report has been expanded to emphasize these findings. Because of the sequential process of reductive chlorination, DCE and vinyl chloride will be reduced later than and typically at a slower rate than PCE or TCE.

The report was not a Risk Assessment or Corrective Action Plan, therefore, evaluation of risk and discussion of long term monitoring, etc. is not part of the report scope. Since a Risk Assessment has already evaluated the area and concluded that there is no risk, the timeframe for degradation to the risk-based threshold has occurred, but this is what would be discussed in the Corrective Measures Study, not in the report of pilot test findings.

Please contact me if you have any questions.

Sincerely,



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C: Ms. Demetra Salisbury, United States Environmental Protection Agency Region VII

Enhanced Bioremediation Pilot Test Report for McDonnell Douglass, Hazelwood, Missouri

Prepared for:
The Boeing Company
St. Louis, Missouri



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MACTEC Project Number 32350035046

April 2, 2004



THIS REPORT, TABLES, AND FIGURES WERE PREPARED UNDER THE DIRECTION OF
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List of Abbreviations and Acronyms

bgs	below ground surface
Boeing	Boeing Company
°C	degrees Celsius
°F	degrees Fahrenheit
DCA	dichloroethane
DCE	dichloroethene
DO	dissolved oxygen
DOC	dissolved organic carbon
Facility	Boeing Tract 1 facility
HRC	Hydrogen Release Compound
MACTEC	MACTEC Engineering and Consulting, Inc.
µg/L	micrograms per liter
mg/L	milligrams per liter
mV	millivolt
ORP	redox potential
PCE	perchloroethylene, tetrachloroethene
PVC	polyvinyl chloride
Redox	oxidation-reduction
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
TCE	trichloroethane
TOC	total organic carbon
TPH	total petroleum hydrocarbon
USEPA	U.S. Environmental Protection Agency
VC	vinyl chloride
VOC	volatile organic compounds

1.0 Introduction

This report presents the results of an enhanced bioremediation pilot study conducted by MACTEC Engineering and Consulting, Inc. (MACTEC) on behalf of McDonnell Douglass, a wholly owned subsidiary of The Boeing Company (Boeing). The objective of the pilot study was to measure the ability of a Hydrogen Release Compound® (HRC) to enhance biological activity of reductive dehalogenating microbes to dechlorinate trichloroethene (TCE) and other chlorinated aliphatic hydrocarbons under anaerobic conditions in shallow groundwater at the Boeing Tract 1 Facility (Facility) located in Hazelwood, Missouri (Figure 1-1). The conclusions and results of the pilot study will assist in the development of a Corrective Measure Study for the Boeing Tract 1 Facility.

2.0 Facility Description

The pilot study was conducted at the former Boeing Fabrication Operations Facility (consisting of Buildings 27, 29 and 29A), which is now operated by GKN Aerospace Services. Aircraft components are manufactured at the Fabrications Operations Facility, which has been in operation at the site since 1941. The Fabrication Operations Facility is located on Boeing Tract 1 North, which is bounded on the west by Lindbergh Boulevard, on the south by Banshee Road, and on the east by Coldwater Creek. McDonnell Boulevard bounds the northern portion of the Facility (Figure 2-1).

The Facility is located on generally flat topography in an area known as the Florissant Basin. The Florissant Basin consists of a broad valley cut by the ancestral Coldwater Creek and tributaries. This basin was subsequently in-filled by unconsolidated clay and organic silt deposits approximately 80 feet thick at the Facility. The bedrock unit underlying the unconsolidated deposits consists of Mississippian Age Ste. Genevieve limestone.

At the pilot test area, the surficial material consisted of silty clay. Plasticity in the soil increased with depth from moderate to high between the surface and 20 feet below ground surface (bgs). The upper 15 feet of soil had abundant iron oxidation staining and contained vertical root traces/worm burrows up to 1/8th inch diameter that were infilled with iron oxidation. Below 20 feet bgs the surficial material consisted of increasingly plastic clay.

Shallow groundwater at the pilot test area was encountered between 2 and 6 feet bgs. The shallow groundwater gradient is to the east. The average facility-wide hydraulic gradient was calculated at 0.0107 feet per foot and the average facility-wide linear groundwater velocity was calculated at 7.6 feet per year. Additional site characterization data regarding the Boeing Tract 1 Facility is presented in the Draft Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report (MACTEC, 2003).

3.0 Technology Description

The most important process for the natural degradation of chlorinated compounds is that of reductive dechlorination. Chlorinated ethenes [tetrachloroethene (PCE), TCE, dichloroethene (DCE), vinyl chloride (VC)] are transformed by sequential dechlorination from PCE to TCE to DCE to VC to ethene (U.S. Environmental Protection Agency (USEPA), 1998). The chlorinated compound is utilized as an electron acceptor, with a chlorine atom removed and replaced with a hydrogen atom. Complete reductive dechlorination produces ethane or methane and carbon dioxide (Figure 3-1).

3.1 Environmental Conditions that Support Reductive Dechlorination

Reductive dechlorination occurs under strongly reducing (anaerobic) conditions and requires carbon as a food source for microbes. Environmental conditions that support reductive dechlorination include:

- Microorganisms capable of degrading the contaminants;
- Oxidation-reduction (redox) potential of the groundwater;
- Sufficient electron donors (e.g. a carbon source);
- Limited competing electron acceptors.

3.1.1 Microorganisms

Reductive dechlorination of chlorinated compounds relies on microorganisms that produce enzymes that degrade the contaminants. Generally, if products of complete dechlorination are evident at a site, microorganisms necessary for dechlorination can be assumed to be present (Wisconsin Department of Natural Resources, 2003). At the Facility, degradation products DCE and VC are present in the shallow groundwater in conjunction with PCE and TCE, indicating that dehalogenating microorganisms are present.

3.1.2 Oxidation-Reduction Potential (ORP)

ORP (redox) of groundwater is a measure of electron activity and is an indicator of the relative tendency of a solution to accept or transfer electrons. In general, a groundwater ORP of less than negative 100 millivolts (mV) indicates that a reductive pathway is likely (USEPA, 1998). However, while ORP can indicate the likelihood of reductive dechlorination occurring, the aquifer redox condition cannot predict the extent to which reductive dechlorination will occur (Loffler et al., 1999). At the Facility, ORP in groundwater was measured to be lower than negative 100 mV in several areas where chlorinated compounds were detected.

3.1.3 Carbon Source

Because chlorinated compounds are utilized as electron acceptors during reductive dechlorination, an appropriate carbon source is required for microbial growth (and resulting production of hydrogen) to occur. Potential carbon sources include low molecular weight organic compounds (lactate, acetate, methanol, glucose, etc.), fuel hydrocarbons, or naturally occurring organic matter. At the Facility the geology of the shallow surficial soil consists of silts and clays of lacustrine (lake) origin with a high organic content. Additionally, anthropogenic carbon sources (fuel hydrocarbons such as fuel oil, jet fuel, and cutting oil) are present at the Facility in several areas where chlorinated compounds were detected.

3.1.4 Competing Electron Acceptors

Dissolved oxygen (DO) is the most favored electron acceptor used by microbes for the biodegradation of organic carbon. Anaerobic bacteria generally cannot function at DO concentrations greater than about 0.5 milligrams per liter (mg/L) and, hence, reductive dechlorination will not occur (USEPA, 1998). After depletion of DO, anaerobic microbes will use nitrate as an electron acceptor, followed by iron (III), sulfate, and finally carbon dioxide (methanogenesis). Each sequential reaction drives the ORP of the groundwater downward. Reductive dechlorination typically requires a redox state at least as anaerobic as sulfate reduction.

Excess concentrations of nitrate (greater than one mg/L) and sulfate (greater than 20 mg/L) may cause competitive exclusion of dechlorination. At the Facility, nitrate and sulfate concentrations in groundwater were generally measured to be lower than these potential competitive levels in the areas where chlorinated compounds were detected.

3.2 Enhanced Bioremediation

Enhanced bioremediation is the process of increasing the rate of contaminant degradation through the addition of nutrients or additives that produce conditions supportive of the natural biodegradation process. HRC, a proprietary polylactate ester manufactured by Regenesys, Inc., is a viscous liquid specially formulated for slow release of lactic acid upon contact with water in the subsurface environment. Lactic acid can be metabolized by native microbes to hydrogen, which is a suitable electron donor for the reductive dechlorination process (Koenigsberg and Farone, 1999).

4.0 Pilot Test Implementation

4.1 Pilot Area Selection

The pilot test area selected was at the Scrap Metal Recycling Dock at the Fabrication Operations Facility. Chlorinated aliphatic hydrocarbons compounds (TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and VC) were detected in the shallow groundwater at the Recycling Dock along with total petroleum hydrocarbons (TPH). The presence of cis-DCE and VC, compounds not known to have been historically used at the Facility, indicated that reductive dechlorination was naturally occurring in this area with potentially TPH being utilized as a carbon source.

The Scrap Metal Recycling Dock is located west of Building 27 (Figure 2-1) and consists of a concrete lined and curbed area approximately 250 feet long by 30 feet wide where aluminum, titanium, and other metal shavings and scrap from the manufacturing process are loaded into tractor trailers to be hauled off-site to a recycling company. The metal shavings contain cutting oil (currently water based) that is allowed to drain from the trailers into the curbed area prior to shipment. The cutting fluid is collected in a sump that is connected to a series of drain inlets in the concrete pad.

Monitoring Well MW3, located within the concrete curbed area in the Recycle Dock, was installed in July 2000 as part of the RFI. Groundwater from this well was sampled once (at installation) for TPH with a concentration of 1,700 micrograms per liter ($\mu\text{g/L}$) gasoline range TPH detected. Well MW3 was sampled for volatile organic compounds (VOCs) seven times during quarterly groundwater sampling prior to the pilot test implementation. PCE has never been detected in MW3. TCE concentrations detected in these seven samples ranged between 1,400 $\mu\text{g/L}$ to 8,000 $\mu\text{g/L}$ with an average concentration of approximately 4,000 $\mu\text{g/L}$. Cis-DCE concentrations ranged from 1,800 to 7,600 $\mu\text{g/L}$ with an average concentration of approximately 3,700 $\mu\text{g/L}$. VC concentrations ranged from 32 $\mu\text{g/L}$ to 130 $\mu\text{g/L}$ with several non-detects at a detection limit of 100 $\mu\text{g/L}$. The average VC concentration detected was approximately 87 $\mu\text{g/L}$. The only other VOCs detected in MW3 were low concentrations of 1,1-dichloroethane (DCA), 1,1-DCE, and trans-DCE which were detected in some of the sampling events. The results of the pre-pilot test groundwater sampling for MW3 are summarized in Table 4-1 and presented graphically in Figure 4-1. Linear curve matching trend lines for each chlorinated compound indicated no increasing or decreasing trends during the two-year period. A complete summary of groundwater sampling analysis and copies of laboratory reports can be found in the Draft RFI report (MACTEC, 2003).

4.2 Pilot Test Design

An area approximately 625 square feet with monitoring well MW3 at the center was chosen as the pilot test area. An injection grid consisting of three rows of three injection borings set 10 feet apart with the middle row staggered 5 feet to the north was planned. The injection grid was located such that MW3 was approximately five feet downgradient (east) of the middle grid row. Due to the location of an underground fire protection water line, the downgradient row of injection borings was located approximately 15 feet east of the center row (Figure 4-2).

The average TCE, cis-DCE and VC concentrations detected in monitoring well MW3, along with additional competing electron acceptor values and additional demand factors such as competing microbial processes and hydrophobic sorption were used to calculate the appropriate HRC application rate. Based on the software program provided by Regenesys, an appropriate application rate of 6 pounds per foot in each injection boring was estimated.

In order to provide for monitoring of groundwater upgradient and downgradient of the pilot test area, two additional monitoring wells were installed at the Recycling Dock on June 10, 2002. Monitoring Well MW3A was installed 29 feet west (upgradient) of MW3 and MW3B was installed 24 feet east (downgradient) of MW3 (Figure 4-2). Construction of these two monitoring wells matched that of MW3 except that 15 feet of well screen was used in each instead of 10 feet. MW3A and MW3B were drilled to a depth of 20 feet bgs and completed with 15 feet of two-inch schedule 40 polyvinyl chloride (PVC), 0.001-inch slotted well screen and solid PVC riser to the surface. Sand pack was placed to two feet above the top of the well screen with a one foot bentonite seal on top of the sand pack. The wells were completed at the surface with flush mount well boxes with one-foot skirts set into concrete. Copies of the boring/monitoring well logs for MW3, MW3A, and MW3B are included as Appendix A.

Based on the design of the pilot test presented in the Pilot Test Work Plan, Boeing obtained an Underground Injection Control permit from the Missouri Department of Natural Resources Clean Water Commission for the pilot test project. A copy of the permit is included as Appendix B.

4.3 HRC Injection

PSA Environmental of Lee's Summit, Missouri conducted the HRC injection on July 19, 2002 under the direction of a MACTEC geologist. A truck mounted Geoprobe® hydraulic soil probing machine was used to install the injection borings using 1.5-inch diameter steel drive rod fitted with an expendable steel point. Each boring was driven to 19 feet bgs and the drill rod was retracted in approximately 1-foot intervals to 4 feet bgs. In two of the borings, a prototype injection drive rod head was used to allow injection in 1-foot intervals during the downward probing. Approximately six pounds of HRC was injected at each 1-foot interval for a total of 90

pounds per injection boring. The HRC material in 4-gallon buckets (30 pounds of HRC) was heated in a water bath to an approximate temperature of 120° Fahrenheit (°F) to increase the viscosity of the HRC. A Geoprobe® GS2000 pump was used to pump the HRC down the drive rods.

Following completion of HRC injection and removal of the drive rod, each boring was temporarily plugged with a four-foot section of 2x2 wood to keep the HRC from pushing back up the open borehole. After one to two hours, the fluid pressure dissipated, and the boreholes were capped with granular bentonite and the concrete surface patched.

4.4 Groundwater Monitoring

Groundwater samples were collected from the three monitoring wells (MW3, MW3A, and MW3B) the day prior to the HRC injection and monthly thereafter for the next year. A final round of groundwater sampling was conducted in January 2004, 19 months after the HRC injection. Groundwater samples were analyzed VOCs by EPA Method 8260.

Quarterly the groundwater samples were analyzed by the laboratory for 14 inorganic parameters: chloride; dissolved organic carbon (DOC); total organic carbon (TOC); ethane; ethene; free carbon dioxide; iron; dissolved iron; dissolved manganese; methane; nitrate; nitrite; sulfate; and sulfide. Additionally, the groundwater samples were analyzed quarterly for five metabolic acids: lactic acid, pyruvic acid, acetic acid, propionic acid, and butyric acid. These acids are indicators of the breakdown of the HRC. Copies of the laboratory reports and chain-of-custody documents for the January 2004 sampling event and the metabolic acid analysis are included in Appendix C. Copies of laboratory reports for the previous VOC analysis are included in the RFI (MACTEC, 2003).

Groundwater samples were collected using a peristaltic pump and dedicated tubing. When possible, the samples were collected using low flow sampling techniques (USEPA, 1996). If drawdown could not be stabilized in a well, the well was sampled after the removal of three well volumes of groundwater and the stabilization of field parameters. Field parameters measured were temperature, pH, conductivity, redox potential (ORP), DO, and ferrous iron.

Immediately upon collection, each sample was properly labeled to prevent misidentification and placed in a shipping container with sufficient ice or ice packs to maintain an internal temperature of four-degrees Celsius (°C) during transport to the laboratory. A completed chain-of-custody form was placed in each shipping container to accompany the samples to the laboratory. VOC and inorganic analysis were conducted by Environmental Science Corporation in Mt. Juliet, Tennessee. Metabolic acid analysis was conducted by Keystone Laboratories in Newton, Iowa.

4.5 Pilot Study Site Disturbance

On November 20, 2002 (154 days following HRC injection) the underground fire protection water line that runs through the Scrap Metal Recycling Dock failed, resulting in a release of an unknown volume of water. The water line runs through the pilot test area, between the center and east rows of injection points. The water line break occurred approximately 30 feet south of the pilot test area and was repaired within 24 hours by excavating an area approximately 20 feet long (north-south) by 10 feet wide (east-west). The monthly groundwater sampling of the pilot test wells was conducted on November 22, 2002.

5.0 Results

A summary of the target VOC analytical results from the pilot test groundwater samples are presented in Table 5-1 and on Figure 5-1. Results of target VOC analytical molar data and molar ratio data are presented in Tables 5-2 and 5-3 and on Figure 5-2. A summary of inorganic analytical analysis is presented in Table 5-4 and on Figure 5-3. A summary of field parameter measurements is presented in Table 5-5 and on Figure 5-4. Results of metabolic acid analysis are presented in Table 5-6.

5.1 Upgradient Well

Monitoring Well MW3A was installed approximately 15 feet upgradient of the HRC injection grid. The results of VOC analysis indicate that chlorinated compound concentrations stayed the same or slightly increased over the 19-month pilot study. TCE concentrations ranged from 150 µg/L to 290 µg/L, cis-DCE concentrations ranged from 160 µg/L to 460 µg/L, trans-DCE concentrations ranged from less than one µg/L to 18 µg/L, and VC concentrations ranged from less than one µg/L to 13 µg/L.

Inorganic analysis and field parameter measurement indicated no discernible trends over the 19-month pilot test with the exception of a one-time drop in the ORP measurement corresponding with the break of the water line just south of the pilot test area. The ORP measurement returned the following month to the normal observed range.

5.2 VOC Analysis

The results of laboratory VOC analysis indicated that TCE concentrations declined 98 percent in MW3 by the first sampling event at 28 days post injection and were more than 99 percent lower through each of the subsequent 11 months. TCE concentration in MW3 at 19-months remained 98.7 percent lower than prior to injection. TCE concentrations declined 100 percent in MW3B by the first sampling event at 28 days post injection and remain below detection limit at 19-months.

The decline in TCE in MW3 was matched by an initial increase in cis-DCE over the first two months after injection. Three months after injection, cis-DCE concentrations declined significantly in MW3 and MW3B with a corresponding increase in vinyl chloride. The vinyl chloride concentration increased in MW3 through the eighth month of the pilot test (February 2003) and declined over the following eight months. The vinyl chloride concentration in MW3B declined each month starting with eighth month after injection.

5.3 Molar Ratio

In an attempt to evaluate the degradation process molar ratio percentages of the chlorinated VOCs through time were assessed. Molar ratios between parent compound and daughter product should remain constant if no biodegradation is occurring. Molar ratio percentages provide a view of the relative proportions of an analyte to the sample as a whole. The total number of moles of organic compounds in a sample is the sum of the moles for each of the analytes (Table 5-2). In order to obtain the molar ratio percentage the concentration of the analyte is divided by its molecular weight to give the number of moles of that analyte in the sample. The molar ratio percentage is obtained by dividing the number of moles of an analyte by the total number of moles of organic compounds in the sample (Table 5-3). Only the targeted analytes (TCE, cis-DCE, and VC) were included in this molar ratio percentage evaluation.

Figure 5-2 presents a graphical presentation of the molar percentages for the analytical results. Monitoring Well MW3A, the upgradient well, shows relatively consistent molar ratio composition throughout the pilot test. Wells MW3 and MW3B both show a decrease in the percentage of TCE after the first 30 days and an increase in the percentage of VC between the third and ninth months post injection with a decrease in VC percentage throughout the remainder of the pilot test, indicative of enhanced reductive dechlorination.

5.4 Inorganic Analysis

A summary of inorganic analysis for the three wells in the pilot test in addition to one non-impacted monitoring well (MW9S) located nearby (approximately 150 feet away) is presented in Table 5-4. Five inorganic compounds useful in the evaluation of the reductive dechlorination stimulated by the injection of HRC at the pilot test area are graphed on Figure 5-3. Ethene was detected in MW3 in both the nine-month and 12-month sampling events and ethane was detected in the nine month sampling, corresponding with the observed decrease in VC, further evidence of the complete dechlorination of VC. The inorganic analysis observed suggests that the effect of the HRC in MW3 began to decline between nine and 12 months post injection as indicated by the slight increase of sulfate concentrations and the return of TOC concentrations to background levels. However, the results of VOC analysis and field parameter measurement indicate that conditions remain favorable for reductive dechlorination and that chlorinated compound degradation is continuing.

5.5 Field Parameters

Field parameters measurements were collected each sampling event and are summarized in Table 5-5. The pH, specific conductivity, and ferrous iron content remained generally consistent in MW3 and MW3B over the course of the pilot test. The DO declined in both MW3 and MW3B

and remained below the pre-injection value with the exception for an increase in DO for approximately 30 days following the water line break. ORP declined in both MW3 and MW3B and remained below the pre-injection value for the duration of the pilot test, although the OPR levels did increase slightly in MW-3 and MW-3B following the water line break.

5.6 Metabolic Acid Analysis

HRC is a polylactic ester that breaks down into volatile acids: acetic, butyric, lactic, propionic, and pyruvic. Metabolic analysis indicated that acids were not detected in the four post injection quarterly sampling events. Additionally, lactic acid was not detected in a groundwater sample collected from well MW3 in October 2001. Lactic acid was detected in the sampling conducted on monitoring well MW3 immediately prior to the injection, this anomalous result may be the result of cross-contamination or laboratory error. The lack of detectable acid concentrations in the post injection sampling may indicate that HRC was quickly being completely broken down to levels below the laboratory detection limit.

6.0 Conclusions

The results of the pilot test provide definitive evidence that reductive dechlorination is occurring within the test area and that the injection of HRC greatly accelerated the rate of chlorinated compound degradation.

- The dechlorination process was observed to go to completion with the reduction of TCE → cis-DCE → VC → ethene → ethane. Clear evidence that reductive dechlorination was going to completion was the detection of ethene and/or ethane in MW-3 in the two samples (March and June of 2003) analyzed for these constituents following the onset of vinyl chloride reduction in the well. Note that ethane and ethene was not detected in January 2004 but that the method detection limit was elevated (10 mg/L) for this analysis. Additionally, the low concentration of vinyl chloride present in MW-3B, would probably preclude the detection of ethane or ethene above the method detection limit of one mg/L.
- Additional evidence that complete dechlorination is occurring is that the vinyl chloride concentrations remained unchanged between the June 2003 and January 2004 sampling event in MW-3 while the cis-DCE concentration declined in this well by 37 percent. Since the vinyl chloride concentration did not change over this period, the vinyl chloride that was created by the reduction of the cis-DCE was offset by the dechlorination of vinyl chloride.
- Based on the reduction in TOC concentrations to pre-injection levels and the slight increase in sulfate observed in monitoring well MW3, the majority of HRC may have been consumed by the 12th month. However, the conditions for reductive dechlorination (low DO, redox potential, and limited competing electron donors) remain and that reductive dechlorination is still occurring as evidenced by the continued chlorinated compound degradation observed through the 19th month in both monitoring wells MW3 and MW3B.
- Groundwater immediately upgradient to the pilot area was unaffected by the pilot test. However, the VOC concentrations present in the upgradient well (MW3A) are an order of magnitude or more lower than the concentrations present prior to the pilot test in MW3 and continued reductive dechlorination is expected as the groundwater migrates into the anaerobic conditions of the pilot test area.
- The DO went up in monitoring wells MW-3 and MW-3B in the samples collected immediately after and 30 days after the water line break. This increase in DO is most likely the result of influence from the water line break and may have temporarily slowed the reductive dechlorination process. However, the DO levels in these two wells returned to low levels in the sampling conducted approximately 60 days after the line break and remained at favorably low levels for the remainder of the pilot test. Therefore, the water line break did not appear to have any long term effect on the results of the pilot test.

- The graphs of the detected VOC constituents provide indirect evidence that desorption of TCE from the soil below the groundwater table occurred for a period of time in monitoring well MW3. Given that TCE tends to degrade faster than DCE, if desorption is occurring, DCE will build up in the system over time. Initially, DCE concentrations rose in well MW3 over the first two months post injection, consistent with the observed rapid degradation of TCE in groundwater. The DCE concentrations declined significantly between the second and third month as the DCE was reduced at a faster rate than it was produced, TCE in groundwater had declined by more than 99 percent over this time. DCE concentrations started to go up beginning the fourth month through the 12th month indicating that DCE was being produced at a rate higher than it was degraded, most likely by the degradation of TCE desorbed from the soil. DCE concentrations fell between the 12th and 19th month indicating that TCE desorption was declining as TCE was removed from the soil.
- This trend of DCE build up was not observed in the downgradient well (MW3B) which indicates that desorption of TCE from the soil was not occurring at that location. Note that well MW3B is located outside of the source area (inside the curbed area at the Recycle Dock) and that screening of soil samples collected during the drilling of MW3B did indicate the presence of organic vapors in the soil.

7.0 References

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Tables

Table 4-1 Summary of Laboratory Pre-Pilot Test Target VOC Data (µg/L), Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

Well ID	Injection Date: 06/19/02							
	Sampling Date	07/28/2000	01/10/2001	05/09/2001	07/24/2001	10/25/2001	03/06/2002	06/18/2002
	Days Since Injection	-691	-525	-406	-330	-237	-105	-1
	Parameter	Results (µg/L)						
MW3	PCE	<100	<5	<100	<1	<25	<1	<100
	TCE	1,700	6,900	3,500	2,700	8,000	1,400	3,900
	cis-1,2-DCE	2,100*	6,000	2,600	2,600	7,600	1,800	3,300
	trans-1,2-DCE	NA	91	<100	62	260	67	<100
	VC	32	120	<100	81	130	75	<100
	Total VOC	1,732	13,111	6,100	5,443	15,990	3,342	7,200

MACTEC, 2004

Notes:

PCE - Tetrachloroethene
TCE - Trichloroethene
cis-1,2-DCE - cis-1,2-Dichloroethene
VC - Vinyl chloride
* - Result of total 1,2-DCE analysis

VOC - Volatile Organic Compound
NA - Not analyzed
< - Not detected above the indicated concentration
µg/L - micrograms per liter

Table 5-1 Summary of Laboratory Target VOC Data (µg/L), Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

		Injection Date: 06/19/2002														Percent Change
Well ID	Sampling Date	06/18/2002	07/18/2002	08/15/2002	09/23/2002	10/15/2002	11/22/2002	12/16/2002	01/20/2003	02/20/2003	03/17/2003	04/17/2003	05/19/2003	06/18/2003	01/14/2004	
	Days Since Injection	-1	29	57	96	118	156	180	215	246	271	302	334	364	574	
Parameter		Results (µg/L)														
MW3A	PCE	<1	<1	<1	<1	<5	<1	<10	<1	<1	<1	<1	<1	<1	<1	0%
	TCE	190	220	240	150	170	190	230	240	220	220	150	220	260	290	52.6%
	cis-1,2-DCE	160	240	270	200	260	290	320	340	290	270	220	320	360	460	187.5%
	trans-1,2-DCE	9.8	12	14	12	10	12	14	17	12	14	11	18	18	<1	-100.0%
	VC	4.9	5.9	5.3	4.8	6	7.5	<10	6.7	9.3	7.1	8.9	8.7	9.9	13	165.3%
	Total VOC	364.7	477.9	529.3	366.8	446	499.5	564	603.7	519.3	497.1	389.9	566.7	647.9	763	109.2%
MW3	PCE	<100	<50	<50	<1	<5	<25	<5	<1	<1	<1	<50	<5	<1	<1	0%
	TCE	3,900	210	51	8	<5	33	5.8	5.2	9.7	6.4	<50	9.1	7.3	34.0	-98.7%
	cis-1,2-DCE	3,300	3,800	4,900	1,300	2,200	2,100	1,600	2,300	2,700	2,700	2,900	3,600	4,100	2,600	-21.2%
	trans-1,2-DCE	<100	73	110	34	44	39	47	54	59	53	<50	77	68	100	0.0%
	VC	<100	<50	84	440	1,400	1,100	1,300	1,600	2,700	2,100	1,600	1,400	1,000	1,000	3900%
	Total VOC	7,200	4,083	5,145	1,782	3,644	3,272	2,953	3,959	5,410	4,806	4,500	5,086	5,175	3,734	-48.1%
MW3B	PCE	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0%
	TCE	8.5	2.1	<2	<1	<1	1.1	<1	<1	<1	<1	<1	<1	<1	<1	-100.0%
	cis-1,2-DCE	130	100	86	65	53	30	27	27	19	15	13	16	16	6.2	-95.2%
	trans-1,2-DCE	2.7	1.7	<2	1.5	1.5	1.4	1.4	1.5	<1	1.1	<1	<1	1.1	<1	-100.0%
	VC	1.2	<1	<2	2.5	15	15	11	15	12	7.7	6.4	5.8	4.2	1.8	50.0%
	Total VOC	142.4	103.8	86	69	69.5	47.5	39.4	43.5	31	22.7	19.4	21.8	21.3	8	-94.4%

MACTEC, 2004

Notes:

PCE - Tetrachloroethene
TCE - Trichloroethene
cis-1,2-DCE - cis-1,2-Dichloroethene
trans-1,2-DCE - trans-1,2-Dichloroethene

VC - Vinyl chloride
VOC - Volatile Organic Compound
µg/L - micrograms per liter
< - Not detected above the indicated concentration

Table 5-2 Summary of Target VOC Molar Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	Injection Date: 06/19/02															
Well ID	Sampling Date		06/18/02	07/18/02	08/15/02	09/23/02	10/15/02	11/22/02	12/16/02	01/20/03	02/20/03	03/17/03	04/17/2003	05/19/2003	06/18/2003	01/14/2004
	Days Since Injection		-1	29	57	96	118	156	180	215	246	271	302	334	364	574
	Parameter	mol. Wt. (g/mol)	Results (µmol/L)													
MW3A	PCE	165.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TCE	131.39	1.4	1.7	1.8	1.1	1.3	1.4	1.8	1.8	1.7	1.7	1.1	1.7	2.0	2.2
	cis-1,2-DCE	96.94	1.7	2.5	2.8	2.1	2.7	3.0	3.3	3.5	3.0	2.8	2.3	3.3	3.7	4.7
	VC	62.50	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2
	Total		3.2	4.2	4.7	3.3	4.1	4.6	5.1	5.4	4.8	4.6	3.6	5.1	5.9	7.2
MW3	PCE	165.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TCE	131.39	29.7	1.6	0.4	0.1	0.0	0.3	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.3
	cis-1,2-DCE	96.94	34.0	39.2	50.5	13.4	22.7	21.7	16.5	23.7	27.9	27.9	29.9	37.1	42.3	26.8
	VC	62.50	0.0	0.0	1.3	7.0	22.4	17.6	20.8	25.6	43.2	33.6	25.6	22.4	16.0	16.0
	Total		63.7	40.8	52.3	20.5	45.1	39.5	37.3	49.4	71.1	61.5	55.5	59.6	58.3	43.1
MW3B	PCE	165.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TCE	131.39	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	cis-1,2-DCE	96.94	1.3	1.0	0.9	0.7	0.5	0.3	0.3	0.3	0.2	0.2	0.1	0.2	0.2	0.1
	VC	62.50	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.0
	Total		1.4	1.0	0.9	0.7	0.7	0.5	0.4	0.4	0.4	0.3	0.2	0.2	0.2	0.2

MACTEC, 2004

Notes:

cis-1,2-DCE - cis-1,2-Dichloroethene
g/mol - grams per mole
µmol/L - micromole per liter

PCE - Tetrachloroethene
TCE - Trichloroethene
VC - Vinyl chloride

a. - For those results less than the laboratory reporting limit, numeric zeros were listed as results and were used for graphing purposes. Detection limits are subject to variation due to sample matrix interference and sample dilution.

Table 5-3 Summary of Target VOC Molar Percentage Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

Well ID	Injection Date: 06/19/02															
	Sampling Date		06/18/02	07/18/02	08/15/02	09/23/02	10/15/02	11/22/02	12/16/02	01/20/03	02/20/03	03/17/03	04/17/03	05/19/03	06/18/03	01/14/04
	Days Since Injection		-1	29	57	96	118	156	180	215	246	271	302	334	364	574
	Parameter	mol. Wt. (g/mol)	Percent (%) of Total Moles													
MW3A	PCE	165.83	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	TCE	131.39	45.55%	39.45%	38.89%	34.79%	31.78%	31.73%	34.65%	33.57%	34.78%	36.61%	32.13%	32.74%	33.82%	30.83%
	cis-1,2-DCE	96.94	51.98%	58.33%	59.30%	62.87%	65.87%	65.64%	65.35%	64.46%	62.13%	60.90%	63.86%	64.54%	63.47%	66.27%
	VC	62.50	2.47%	2.22%	1.81%	2.34%	2.36%	2.63%	0.00%	1.97%	3.09%	2.48%	4.01%	2.72%	2.71%	2.91%
	Total		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
MW3	PCE	165.83	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	TCE	131.39	46.58%	3.92%	0.74%	0.30%	0.00%	0.64%	0.12%	0.08%	0.10%	0.08%	0.00%	0.12%	0.10%	0.60%
	cis-1,2-DCE	96.94	53.42%	96.08%	96.69%	65.38%	50.32%	54.82%	44.19%	48.06%	39.16%	45.29%	53.89%	62.30%	72.48%	62.26%
	VC	62.50	0.00%	0.00%	2.57%	34.32%	49.68%	44.54%	55.69%	51.86%	60.74%	54.63%	46.11%	37.58%	27.42%	37.14%
	Total		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
MW3B	PCE	165.83	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	TCE	131.39	4.54%	1.53%	0.00%	0.00%	0.00%	1.77%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	cis-1,2-DCE	96.94	94.11%	98.47%	100.00%	96.30%	77.94%	65.49%	71.05%	64.29%	61.29%	66.08%	67.01%	73.39%	79.21%	77.50%
	VC	62.50	1.35%	0.00%	0.00%	3.70%	22.06%	32.74%	28.95%	35.71%	38.71%	33.92%	32.99%	26.61%	20.79%	22.50%
	Total		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

MACTEC, 2004

Notes:

PCE - Tetrachloroethene
TCE - Trichloroethene
cis-1,2-DCE - cis-1,2-Dichloroethene

VC - Vinyl chloride
g/mol - Grams per mole
mol. Wt. - Molecular weight

a. - For those results less than the laboratory reporting limit, numeric zeros were listed as results and were used for graphing purposes. Detection limits are subject to variation due to sample matrix interference and sample dilution.

Table 5-4 Summary of Laboratory Groundwater Quality Parameter Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

		Injection Date: 06/19/2002											
Well ID	Sampling Date†	01/10/2001	05/09/2001	07/24/2001	10/25/2001	03/06/2002	06/18/2002	08/15/2002	12/16/2002	03/17/2003	06/18/2003	01/14/2004	
	Days Since Injection	-525	-406	-330	-237	-105	-1	57	180	271	364	574	
	Parameter	Results (mg/L)											
MW3A	Chloride	NI	NI	NI	NI	NI	480	640	610	550	690	690	
	DOC	NI	NI	NI	NI	NI	2.3	1.1	1.7	1.0	1.2	2.6	
	TOC	NI	NI	NI	NI	NI	2.2	1.1	1.6	1.4	1.2	1.4	
	Ethene	NI	NI	NI	NI	NI	<1	<1	<1	<1	<1	<10	
	Ethane	NI	NI	NI	NI	NI	<1	<1	<1	<1	<1	<10	
	Methane	NI	NI	NI	NI	NI	<1	<1	<1	<1	<1	<1	
	Manganese (dissolved)	NI	NI	NI	NI	NI	1.2	1.3	0.73	0.84	0.8	0.96	
	Iron (total)	NI	NI	NI	NI	NI	0.89	74	0.037	0.069	0.053	<0.050	
	Iron (dissolved)	NI	NI	NI	NI	NI	<0.02	0.22	<0.02	<0.05	<0.05	0.053	
	Nitrate (as N)	NI	NI	NI	NI	NI	0.48	<0.1	0.288	<0.1	0.19	<0.1	
	Nitrite (as N)	NI	NI	NI	NI	NI	<0.1	<1.0	<2.5	<0.1	<0.1	<0.1	
	Sulfate	NI	NI	NI	NI	NI	85	95	95.9	95	92	92	
	Sulfide	NI	NI	NI	NI	NI	<0.10	<0.02	<0.02	<0.05	<0.05	<0.05	
	Free Carbon Dioxide	NI	NI	NI	NI	NI	150	120	160	170	130	180	
MW3	Chloride	417	395	460	490	580	450	430	590	530	530	480	
	DOC	<1	1.8	1.6	1	<1	1.8	7.1	2.3	1.6	1.4	2.0	
	TOC	1	1.85	1.7	1.2	1	1.6	7.2	2.5	2.1	<1.0	1.7	
	Ethene	NA	NA	NA	NA	<1	<1	<1	<1	1.2	<1	<10	
	Ethane	NA	NA	NA	NA	<1	<1	<1	<1	78	<1	1.6	
	Methane	NA	NA	NA	NA	<1	<1	<1	<1	78	<1	1.6	
	Manganese (dissolved)	NA	NA	NA	NA	NA	2.1	1.8	1.9	2.0	1.9	2.1	
	Iron (total)	3.4	4	NA	5.5	5.6	4.9	5.6	5.5	5.8	5.3	5.8	
	Iron (dissolved)	NA	NA	NA	NA	NA	<0.02	<0.02	0.051	0.78	1.1	0.7	
	Nitrate (as N)	<0.03	<0.1	0.2	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Nitrite (as N)	<0.03	<0.1	<0.1	<0.1	<1	<0.1	<1.0	<2.5	<0.1	<0.1	<0.1	
	Sulfate	73.9	80	80	86	87	87	30	22.6	28	39	41	
	Sulfide	NA	NA	NA	NA	NA	<0.1	<0.02	<0.02	<0.05	<0.05	0.077	
	Free Carbon Dioxide	NA	NA	NA	NA	100	150	110	130	110	120	140	
MW3B	Chloride	NI	NI	NI	NI	NI	840	870	830	870	1,000	1,400	
	DOC	NI	NI	NI	NI	NI	1.6	1.3	1.6	1.2	<1	1.4	
	TOC	NI	NI	NI	NI	NI	1.4	<1	1.4	1.1	<1	<1	
	Ethene	NI	NI	NI	NI	NI	<1	<1	<1	<1	<1	<10	
	Ethane	NI	NI	NI	NI	NI	<1	<1	<1	<1	<1	<10	
	Methane	NI	NI	NI	NI	NI	<1	<1	<1	<1	<1	<1	
	Manganese (dissolved)	NI	NI	NI	NI	NI	5.5	4.9	4.9	5.3	5.2	6.7	
	Iron (total)	NI	NI	NI	NI	NI	5.7	12	8.3	11	12	16	
	Iron (dissolved)	NI	NI	NI	NI	NI	0.63	0.06	0.8	5.4	7.9	11	
	Nitrate (as N)	NI	NI	NI	NI	NI	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Nitrite (as N)	NI	NI	NI	NI	NI	<1.0	<1.0	<2.5	<0.5	<0.2	<0.1	
	Sulfate	NI	NI	NI	NI	NI	38	32	29.1	31	34	33	
	Sulfide	NI	NI	NI	NI	NI	<0.10	<0.02	<0.02	<0.05	<0.05	<0.05	
	Free Carbon Dioxide	NI	NI	NI	NI	NI	89	120	110	88	77	120	
MW9S	Chloride	NS	NS	NS	NS	NS	5,200	5,200	5,500	5,200	5,400	NS	
	DOC	NS	NS	NS	NS	NS	<1	1.4	1.6	1.4	1.3	NS	
	TOC	NS	NS	NS	NS	NS	<1	1.5	1.5	1.8	<1	NS	
	Ethene	NS	NS	NS	NS	NS	<1	<1	<1	<1	<1	NS	
	Ethane	NS	NS	NS	NS	NS	<1	<1	<1	<1	<1	NS	
	Methane	NS	NS	NS	NS	NS	<1	<1	<1	<1	<1	NS	
	Manganese (dissolved)	NS	NS	NS	NS	NS	NA	NA	NA	6.4	4.9	NS	
	Iron (total)	NS	NS	NS	NS	NS	NA	18	NA	18	17	NS	
	Iron (dissolved)	NS	NS	NS	NS	NS	NA	NA	NA	16	0.3	NS	
	Nitrate (as N)	NS	NS	NS	NS	NS	<1	<0.1	0.25	<0.1	<0.4	NS	
	Nitrite (as N)	NS	NS	NS	NS	NS	<1	<10	<2.5	<0.1	<10	NS	
	Sulfate	NS	NS	NS	NS	NS	140	140	150	140	150	NS	
	Sulfide	NS	NS	NS	NS	NS	NA	NA	NA	<0.05	<0.05	NS	
	Free Carbon Dioxide	NS	NS	NS	NS	NS	250	170	350	<10	180	NS	

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Notes:

DOC - Dissolved organic carbon

TOC - Total organic carbon

N - Nitrogen

mg/L - milligrams per liter

† - Samples may be collected on two consecutive days. The first day of sampling is used for the sampling date on this table and for the dates plotted on the attached figures.

< - Not detected above the indicated concentration

NI - Well not installed

NA - Not analyzed

NS - Not sampled

Table 5-5 Summary of Field Groundwater Quality Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

Well ID	Injection Date: 06/19/2002															Optimum Value
	Collection Date‡	06/18/2002	07/18/2002	08/15/2002	09/23/2002	10/15/2002	11/22/2002	12/16/2002	01/20/2003	02/20/2003	03/17/2003	04/17/2003	05/19/2003	06/18/2003	01/14/2004	
	Days Since Injection	-1	29	57	96	118	156	180	215	246	271	302	334	364	574	
	Parameter	Results														
MW3A	Final pH	7.03	6.74	6.71	6.66	6.74	6.79	6.79	6.63	6.87	6.76	6.75	6.76	6.87	6.06	5 < pH < 9 NA >20 <0.5 < -100 >1
	Final Conductivity (uS)	2,380	2,510	2,810	2,830	2,720	2,840	2,240	2,840	2,650	2,840	2,820	2,860	2,850	2,990	
	Final Temperature (C)	19.4	20.2	21.7	22.7	20.5	17.5	15.3	12.9	12.2	14.2	14.9	17.9	20.5	14.3	
	Final Dissolved Oxygen (mg/L)	4.12	0	0.34	0.87	0.12	0.79	0.89	0.0	0.2	0.6	0.25	0.0	0.0	0.65	
	Final ORP (mvolts)	64	-11	11	-14	74	-185	-7	115	100	46	60	47	18	26	
	Ferrous (Fe2+) Iron (mg/L)	0.4	0.8	0.0	NS	0.0	0.0	0.2	0.0	0.0	0.4	0.4	0.4	0.2	0.0	
MW3	Total Volume Purged (gallons)	8.0	9.0	9	13.5	3	3	2.5	2.25	2	3.25	4.5	2.5	3.5	2.5	5 < pH < 9 NA >20 <0.5 < -100 >1
	Final pH	6.88	6.80	6.75	6.72	6.78	6.81	6.81	6.76	6.78	6.79	6.95	6.83	6.88	7.34	
	Final Conductivity (uS)	2,450	2,360	2,270	2,450	2,330	2,260	1,930	2,470	2,490	2,520	2,490	2,490	2,420	2,400	
	Final Temperature (C)	20.1	22.3	21.8	22.0	20.1	16.3	15.4	15	15.3	15.1	18.4	20.9	16.8	16.8	
	Final Dissolved Oxygen (mg/L)	0.34	0.0	0.2	0.52	0.0	1.28	1.44	0.0	0.07	0.0	0.31	0.0	0.0	0.25	
	Final ORP (mvolts)	-40	-209	-145	-185	-237	-305	-151	-166	-139	-182	-151	-244	-183	-206	
MW3B	Ferrous (Fe2+) Iron (mg/L)	3.2	2.8	2.8	NS	2.6	3	2.2	3.4	2.4	1.6	2.8	3.0	3.4	NS	5 < pH < 9 NA >20 <0.5 < -100 >1
	Total Volume Purged (gallons)	2	1.3	7	1.5	2.5	7.5	1.5	2.5	2.5	2.5	2.5	1.5	2.0	7.5	
	Final pH	6.71	6.59	6.54	6.45	6.55	6.56	6.53	6.61	6.61	6.67	6.53	6.7	6.63	7.6	
	Final Conductivity (uS)	3,400	3,320	3,470	3,550	3,410	3,310	2,580	3,390	3,220	3,550	3,600	3,630	3,760	4,290	
	Final Temperature (C)	24.5	21.4	22.9	24.6	22.6	18.6	16.6	14.8	14.2	15.8	15.3	18.8	21.3	16.2	
	Final Dissolved Oxygen (mg/L)	2.25	0.0	0.38	0.38	0.0	0.45	1.11	0.0	0.21	0.02	0.25	0.0	0.0	0.61	
	Final ORP (mvolts)	23	-96	-84	-73	-79	-56	-99	-28	5	-43	-23	-69	-62	-50	5 < pH < 9 NA >20 <0.5 < -100 >1
	Ferrous (Fe2+) Iron (mg/L)	2.4	2.6	2.2	NS	2.6	2.4	2.8	2.6	3.2	2	2.8	2.6	4.6	5.6	
	Total Volume Purged (gallons)	2.8	8.8	9	1.5*	3	3.25	2.5	1.75	2.25	2.75	3.75	2.3	1.8	3.5	
Notes:																
* - Volume not measured - estimated																

Notes:

* - Volume not measured - estimated purge volume.

C - Degrees Celsius

uS - microsiemens

‡ Samples may be collected on two consecutive days. The first day of sampling is used for the sampling date on this table and for the dates plotted on the attached figures.

mvolts - millivolts

NS - Not sampled

NA - Not applicable

mg/L - milligrams per liter

ORP - Oxidation Reduction Potential

Bold - Indicates result in optimum value range

MACTEC, 2004

Table 5-6 Summary of Metabolic Acid Analysis Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	Injection Date: 6/19/2002						
Well ID	Sampling Date ^a	10/25/2001	6/18/2002	9/23/2002	12/16/2002	3/18/2003	6/18/2003
	Days Since Injection	-236	-1	96	180	272	364
	Parameter	Results (mg/L)					
MW3A	Acetic Acid	NI	<1	<1	<1	<1	<1
	Butyric Acid	NI	<1	<1	<1	<1	<1
	Lactic Acid	NI	<1	<1	<1	<1	<1
	Propionic Acid	NI	<1	<1	<1	<1	<1
	Pyruvic Acid	NI	<0.1	<0.1	<0.1	<0.1	<0.1
MW3	Acetic Acid	NA	<1	<1	<1	<1	<1
	Butyric Acid	NA	<1	<1	<1	<1	<1
	Lactic Acid	<1	26.6	<1	<1	<1	<1
	Propionic Acid	NA	<1	<1	<1	<1	<1
	Pyruvic Acid	NA	<0.1	<0.1	<0.1	<0.1	<0.1
MW3B	Acetic Acid	NI	<1	<1	<2	<1	<1
	Butyric Acid	NI	<1	<1	<2	<1	<1
	Lactic Acid	NI	<1	<1	<2	<1	<1
	Propionic Acid	NI	<1	<1	<2	<1	<1
	Pyruvic Acid	NI	<0.1	<0.1	<0.2	<0.1	<0.1

MACTEC, 2004

Notes:

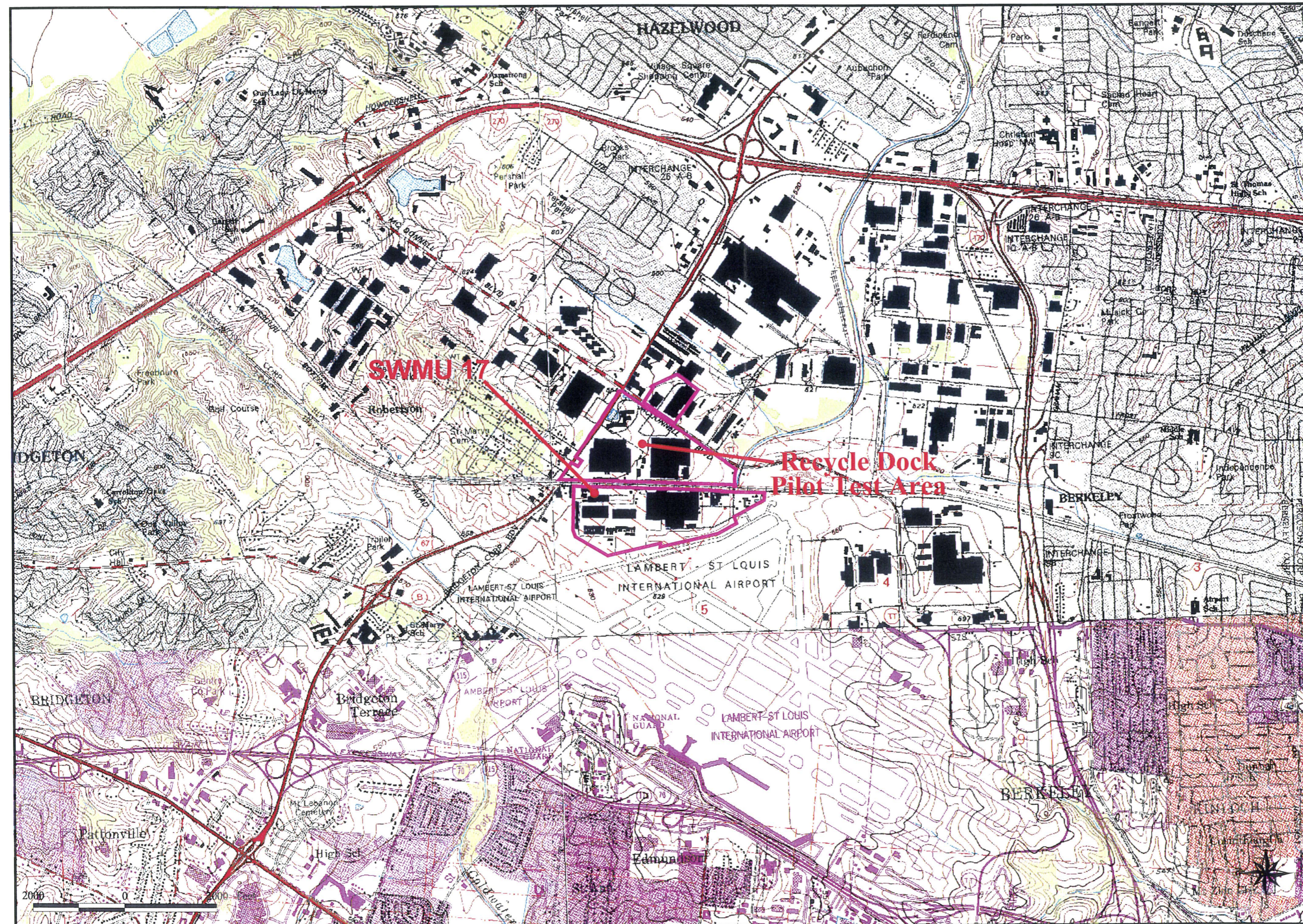
- < - Not detected above the indicated concentration
- NI - Well not installed
- NA - Not analyzed
- a. - Samples may be collected on separate days. The date that MW3 was sampled is used for the sampling date on this table and for the dates plotted on the attached figures.
- mg/L - milligrams per liter

Figures

Figure 1-1
Facility Location Map
Enhanced Bioremediation
Pilot Test
Boeing Tract 1,
Hazelwood, Missouri

Legend

 Boeing Tract 1



Source: USGS Clayton,
Creve Coeur, Florissant,
and St. Charles 7.5 Minute
Quads.

Scale

1:24000

1" = 2000'





Drawn by: BSM Approved by:

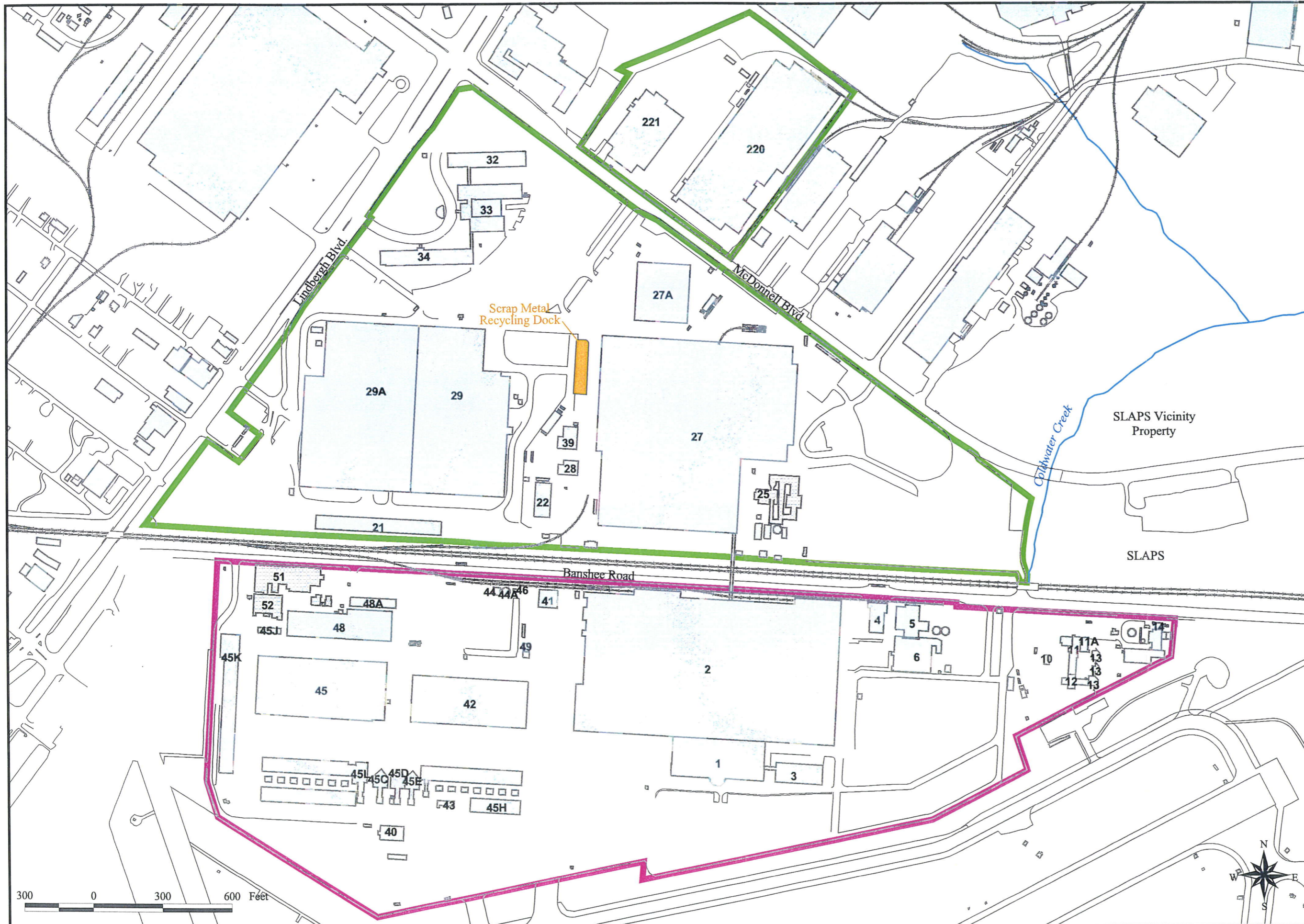
Checked by: Date: February 3, 2004

 MACTEC, Inc.

Figure 2-1
Facility Map
Enhanced Bioremediation
Pilot Test
Boeing Tract 1,
Hazelwood, Missouri

Legend

-  Existing Building
-  Demolished Building
-  Boeing Tract 1 North
-  Boeing Tract 1 South



Scale

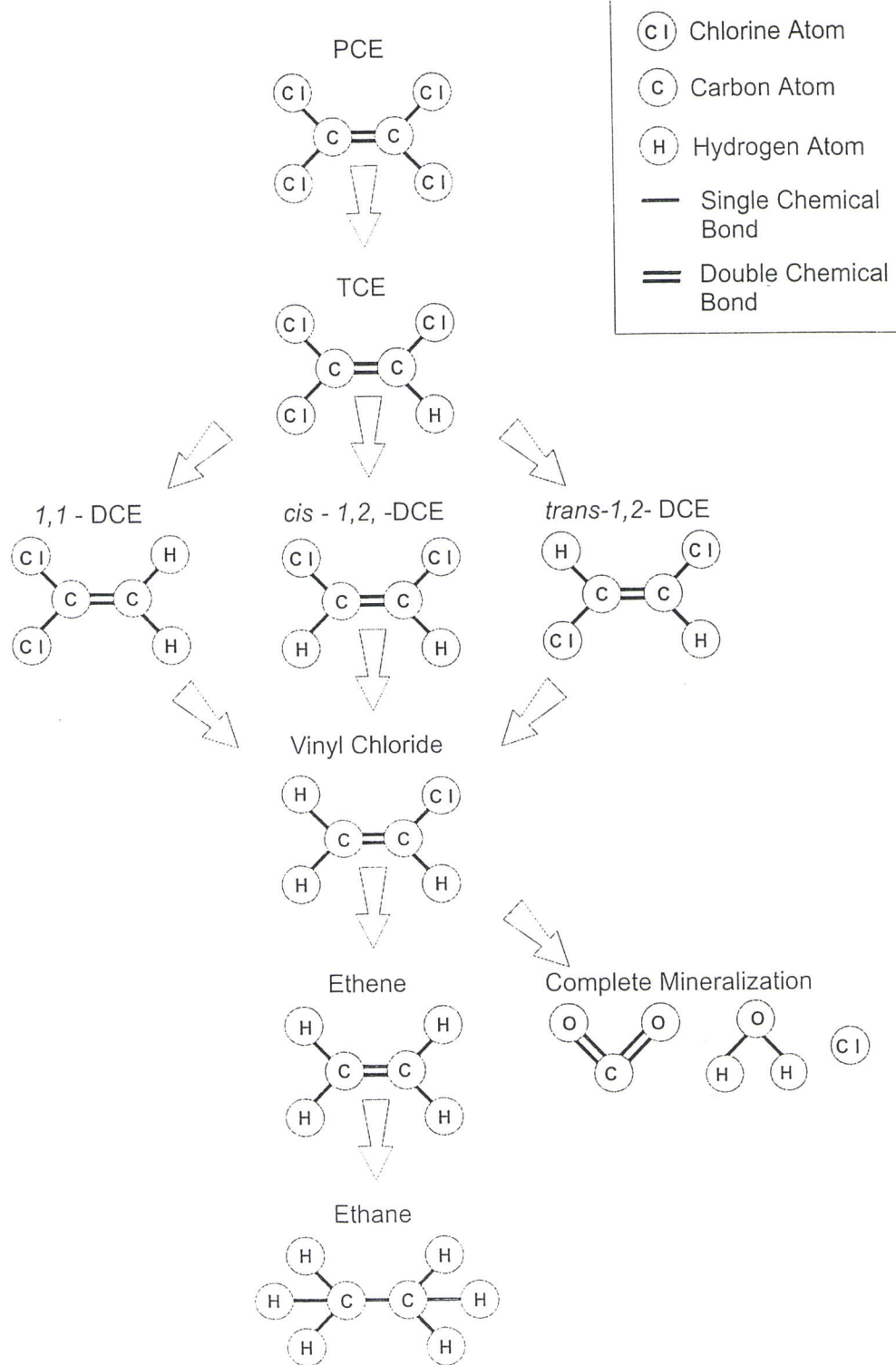
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1" = 300'

Drawn by: BSM Approved by:

Checked by: Date: February 3, 2004

 MACTEC, Inc.



Source: USEPA, 1998

Figure 3-1
Reduction Dehalogenation of Chlorinated
Ethenes
Enhanced Bioremediation Pilot Test
Boeing Tract 1
Hazelwood, Missouri

Drawn by: DLB
 Checked by: LMS
 Approved by:
 Date: 2/4/2004

 **MACTEC**

Well MW3
Target Volatile Organic Compound Analysis

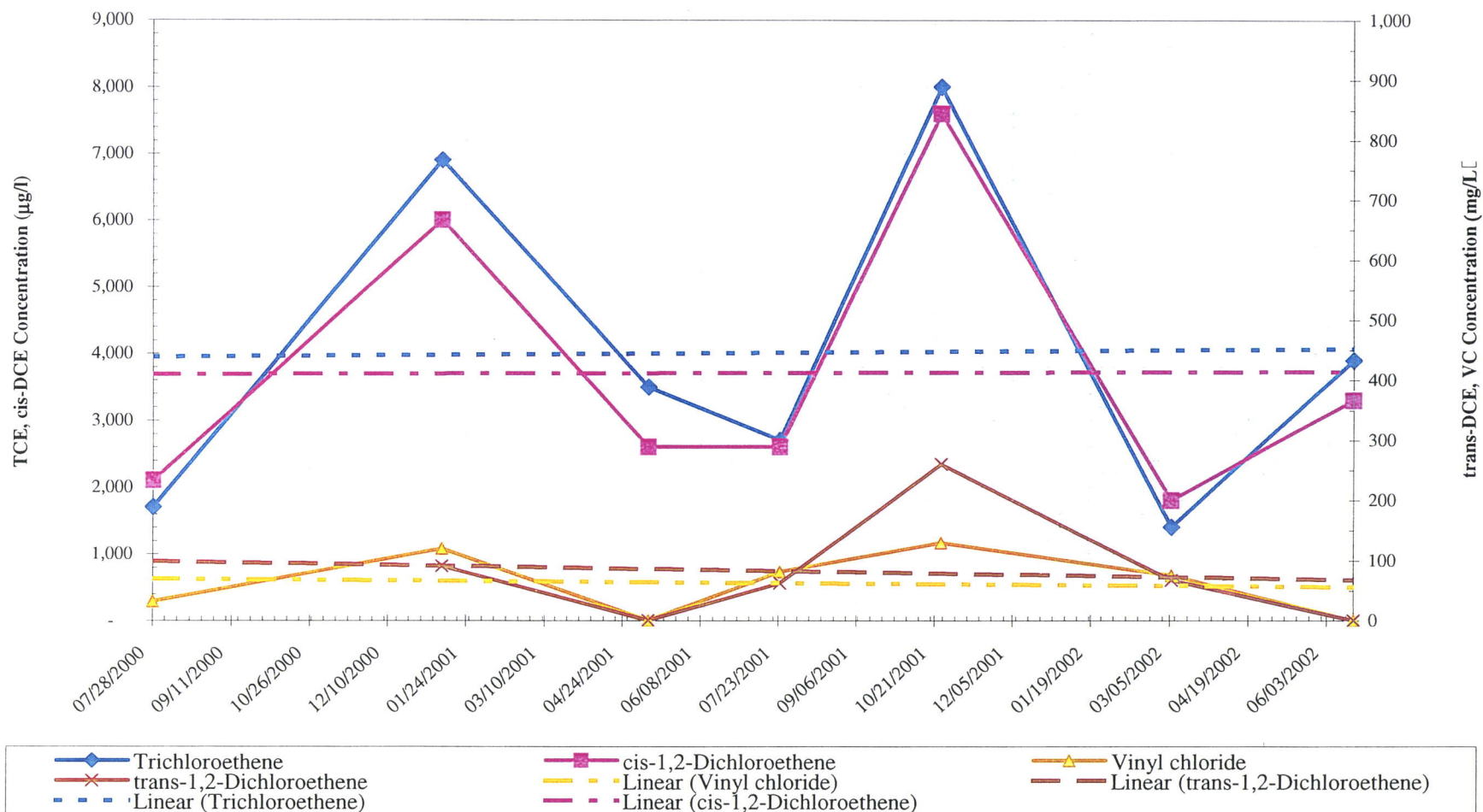


Figure 4-1 Summary of Pre-Pilot Test Target VOC Analysis from MW3
Enhanced Bioremediation Pilot Test
Boeing Tract 1
Hazelwood, Missouri

Drawn by: DLB
Checked by: LMS
Approved by:
Date: 2/4/2004



Figure 4-2
Pilot Test Site Map
Enhanced Bioremediation
Pilot Test,
Boeing Tract 1,
Hazelwood, Missouri

Legend

- Shallow Well
- Deep Well
- Shallow Piezometer
- ▲ RFI Shallow Boring/
Temp. Piezometer
- Industrial Sewer Intake
- Industrial Sewer Manhole
- Water Line
- Industrial Sewer Line

Scale

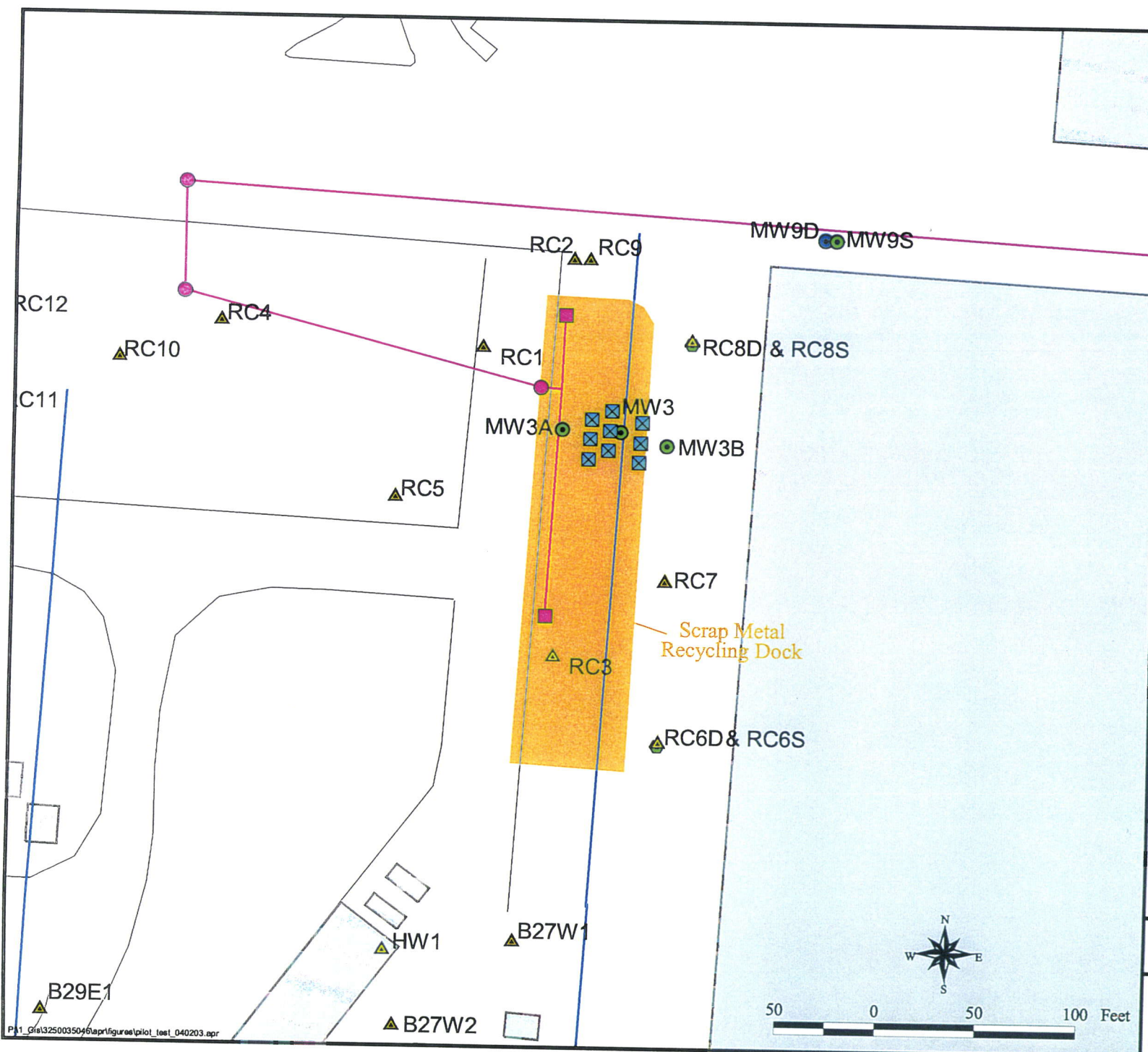
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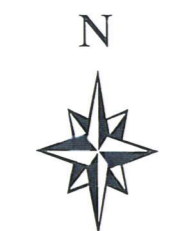
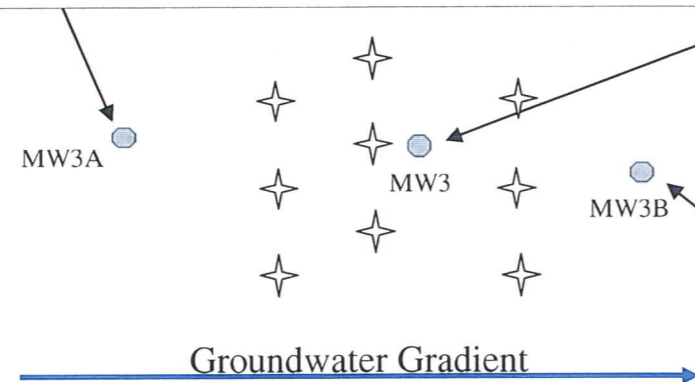
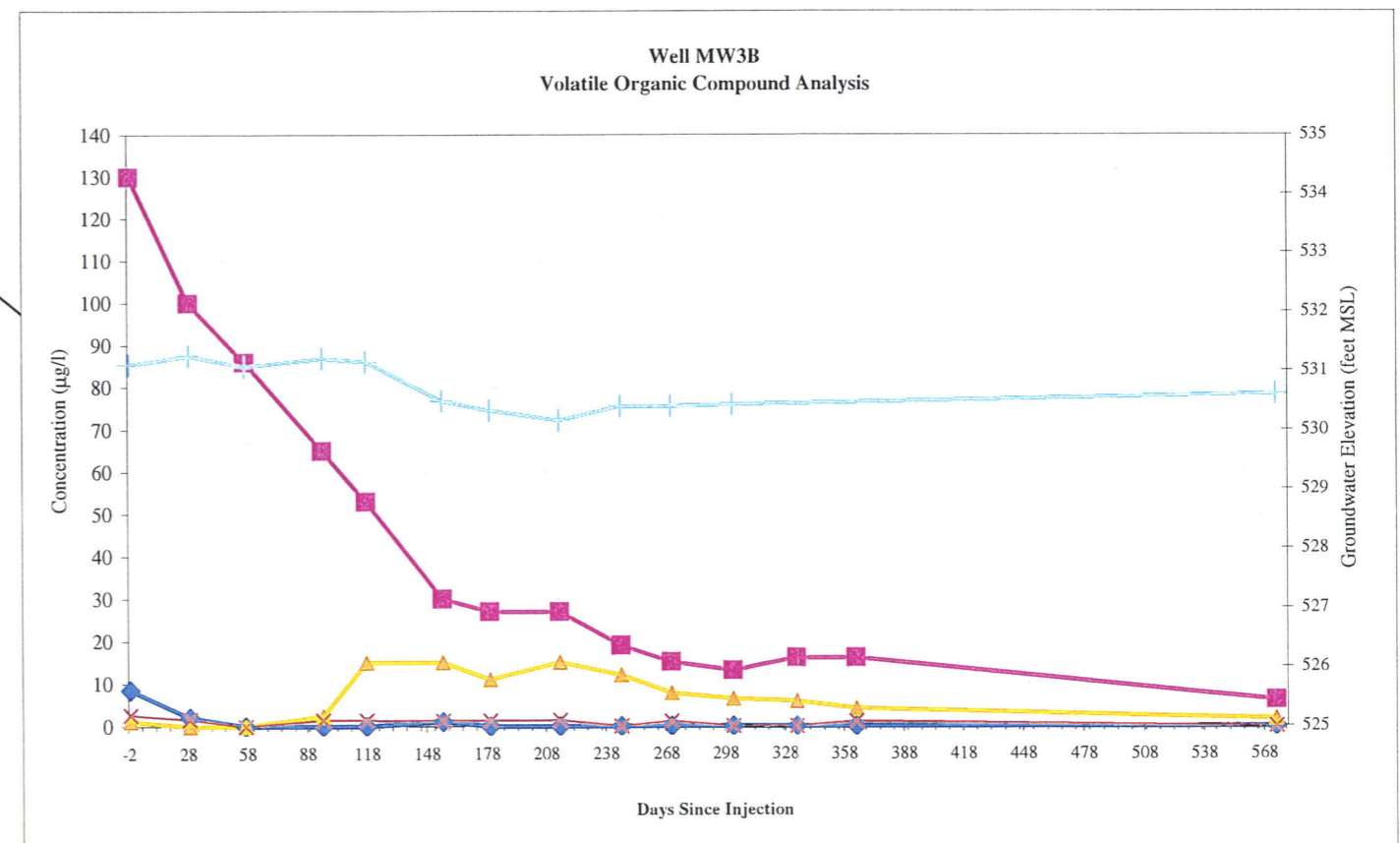
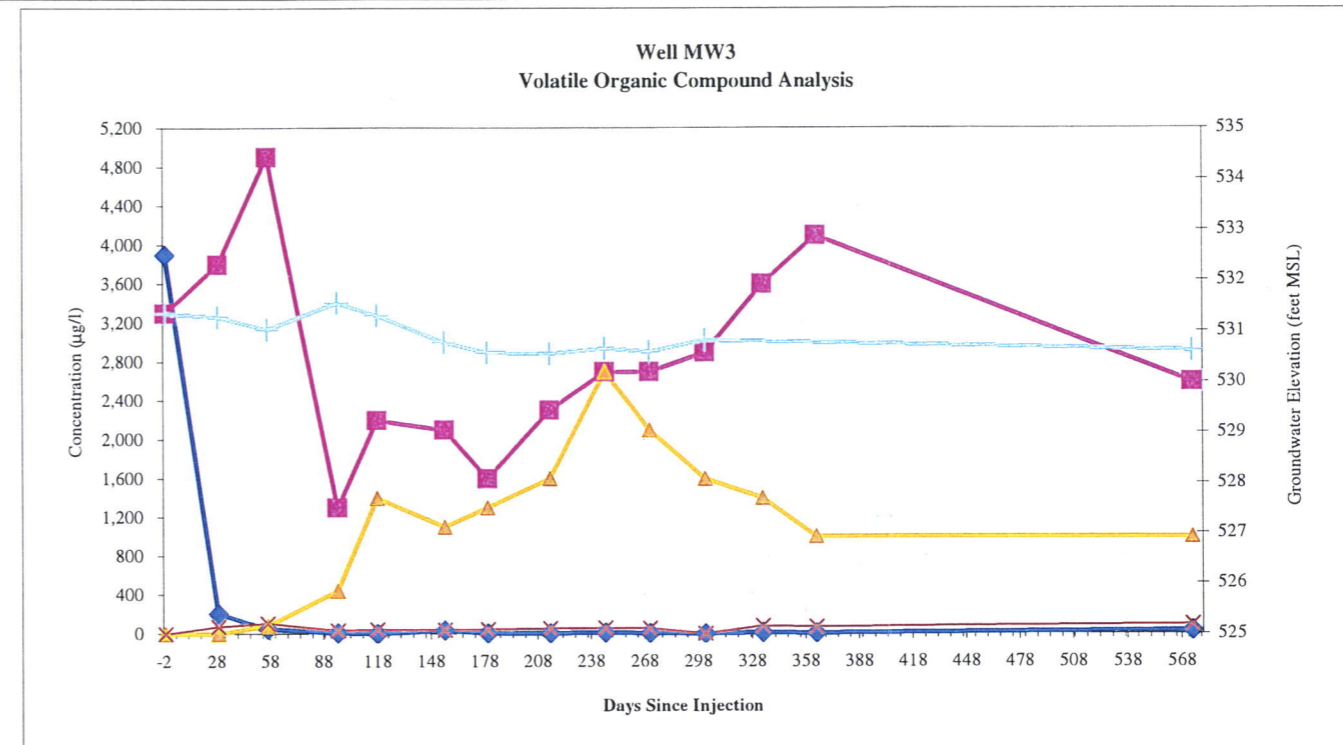
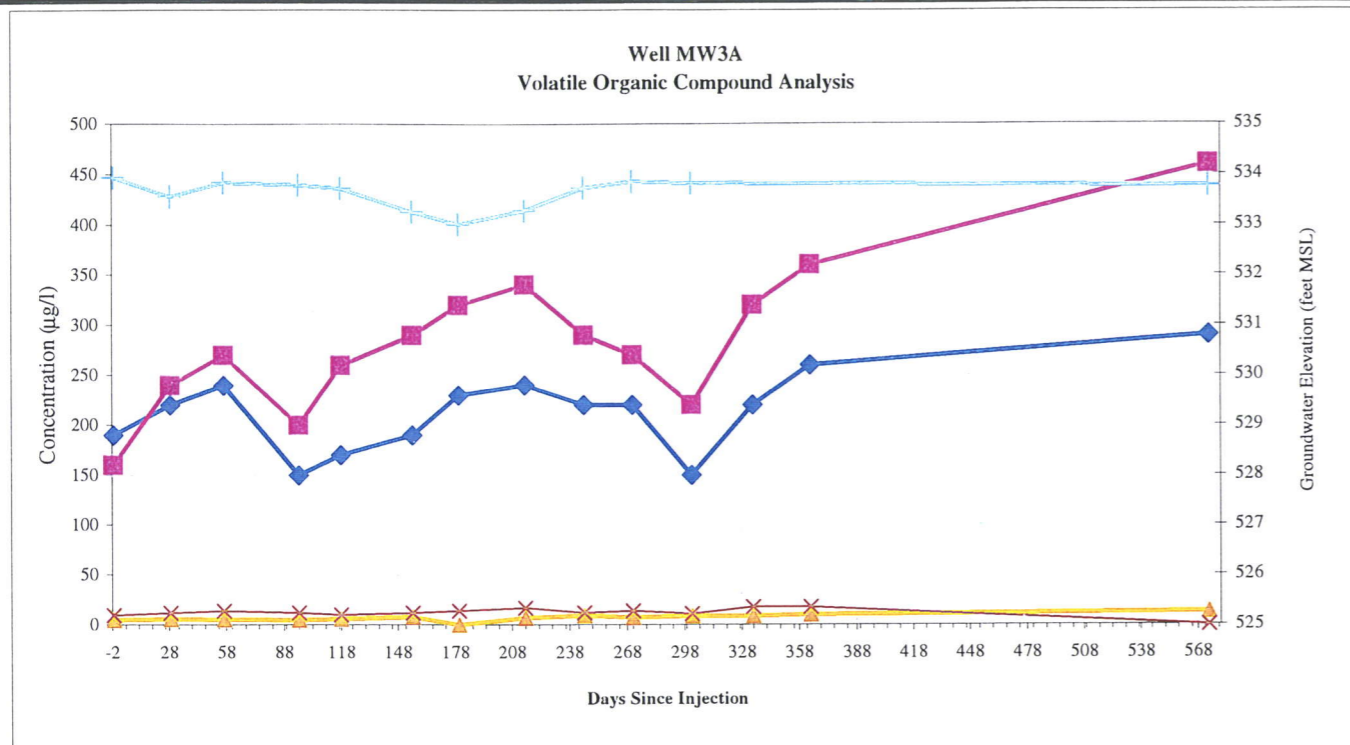
1" = 150'

Drawn by: BSM Approved by:

Checked by: Date: February 3, 2004

 MACTEC, Inc.





Scale: 1" = 20'

LEGEND



Monitoring Well



HRC Injection Point

—◆— Trichloroethene

—■— cis-1,2-dichloroethene

—×— trans-1,2-dichloroethene

—▲— Vinyl chloride

—+— Groundwater Elevation (MSL)

feet MSL = feet above mean sea level
VOC concentrations units are micrograms per liter (µg/L)

Figure 5-1 Summary of Target VOC Analysis Data
Enhanced Bioremediation Pilot Test
Boeing Tract 1
Hazelwood, Missouri

Drawn by: DLB

Approved by:

Checked by: LMS

Date: 02/03/2004



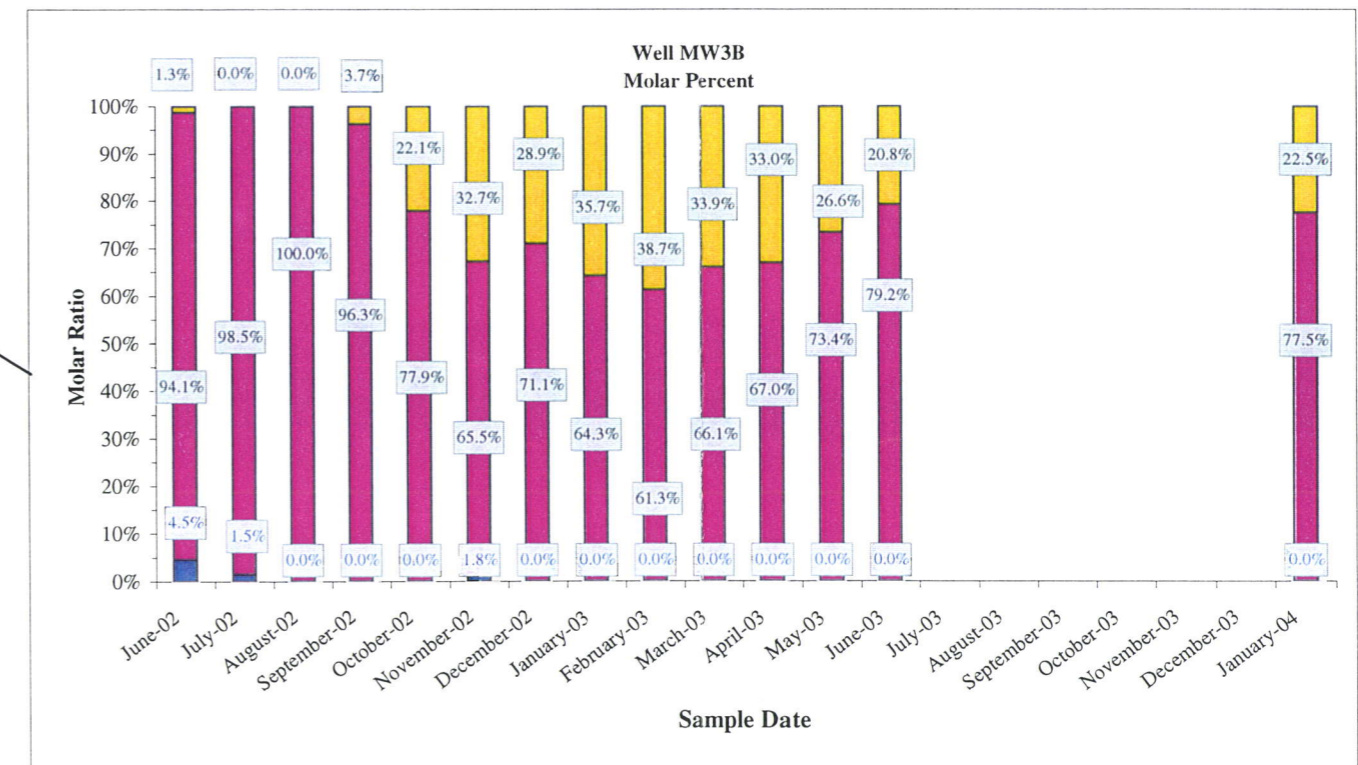
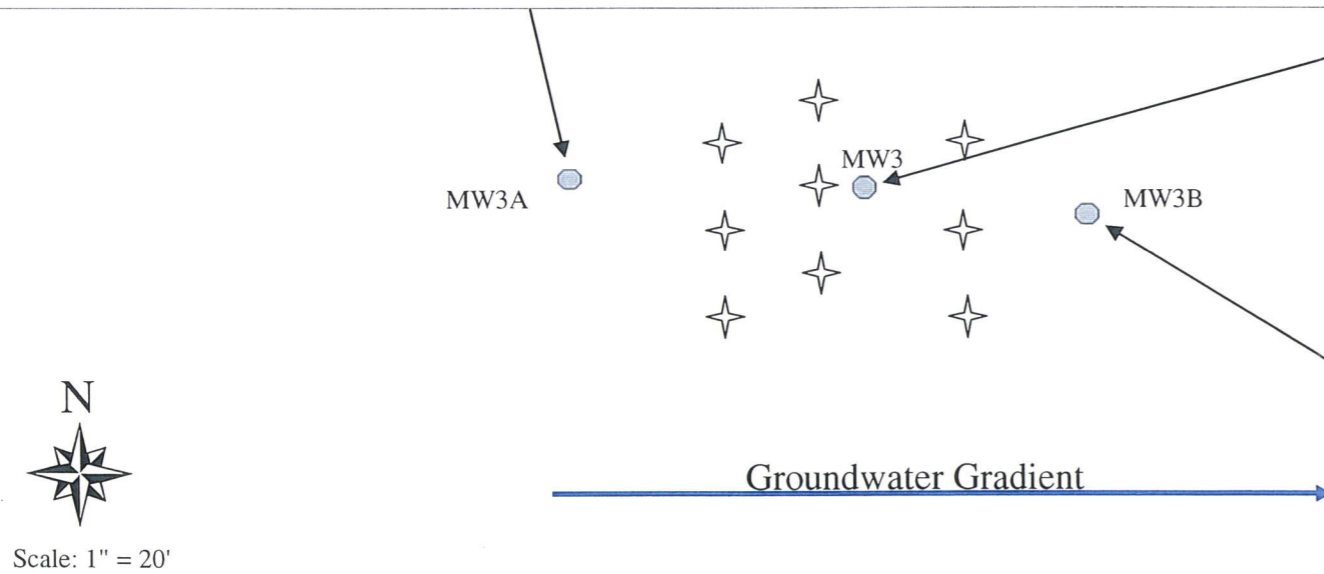
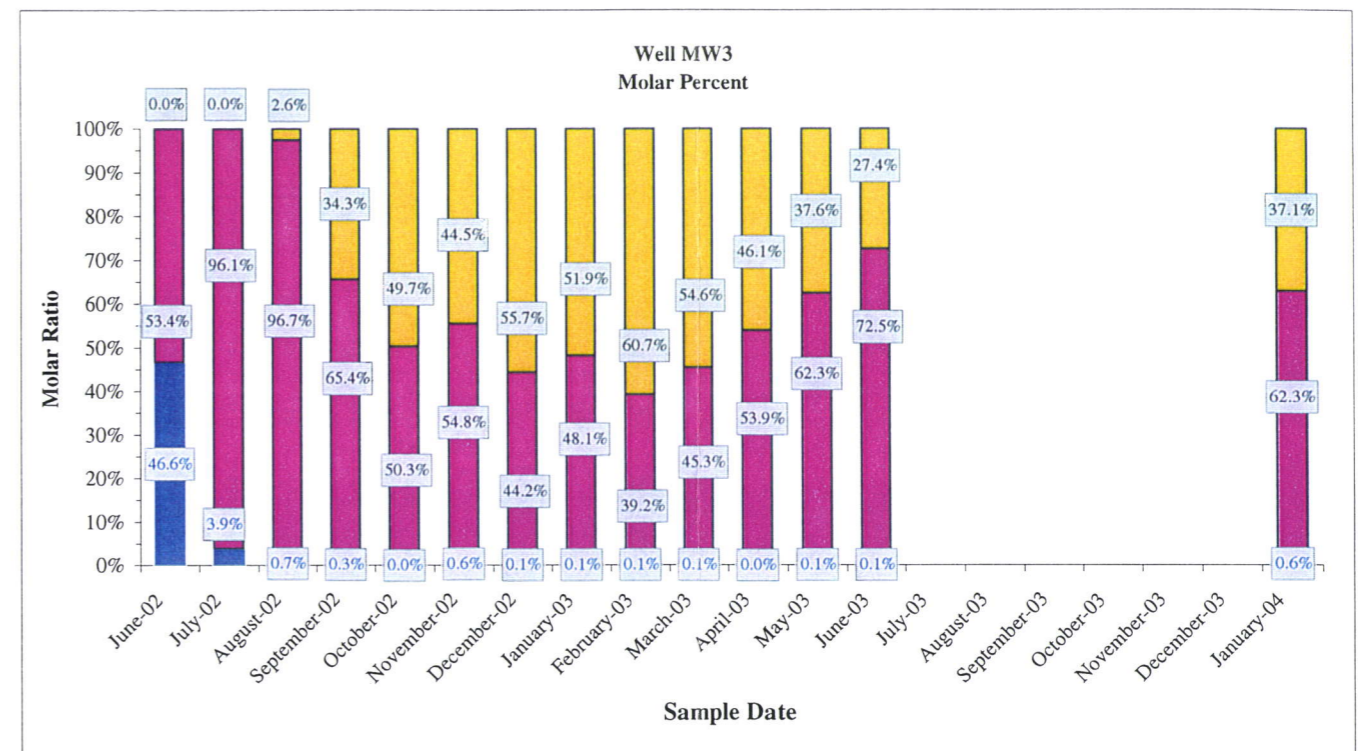
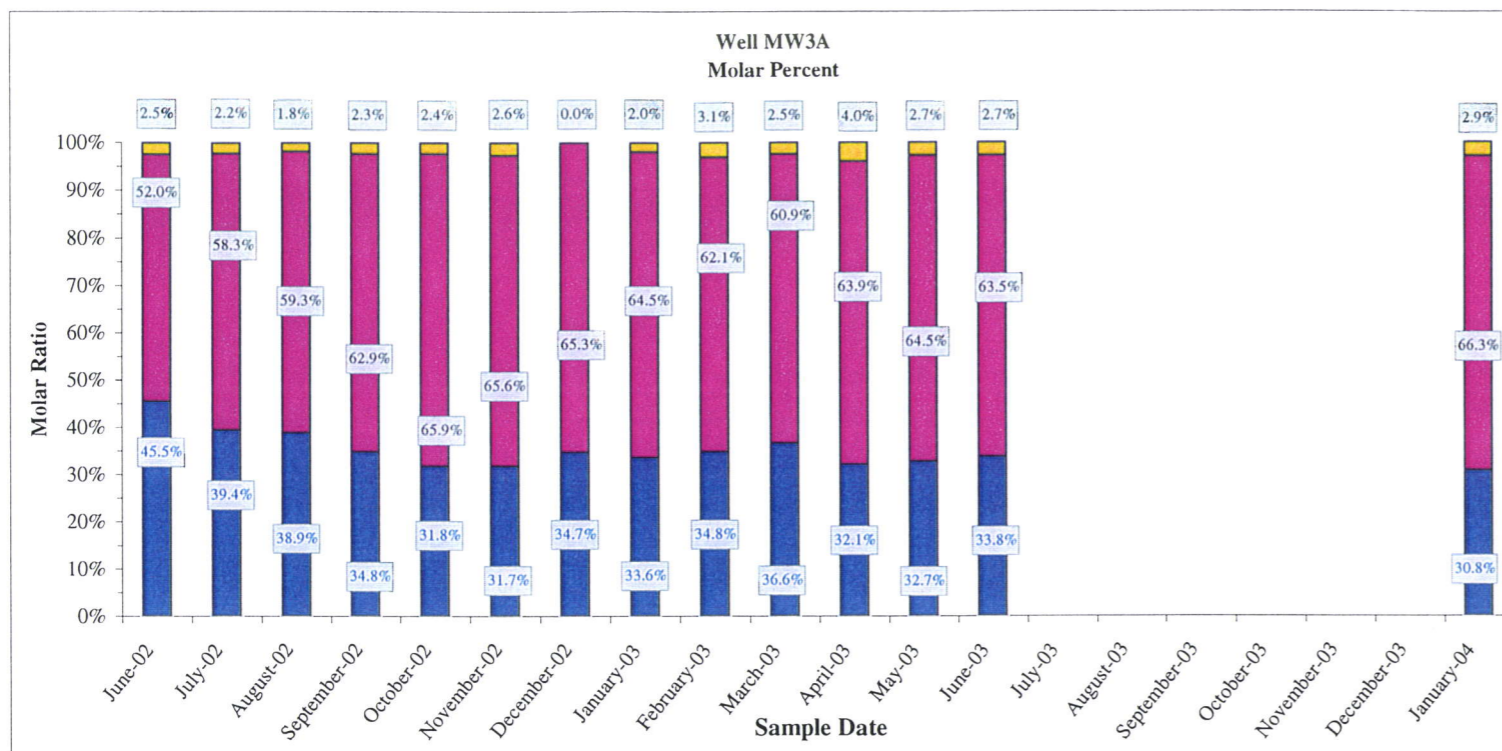


Figure 5-2 Summary of Target VOC Molar Percentage Data
Enhanced Bioremediation Pilot Test
Boeing Tract 1
Hazelwood, Missouri

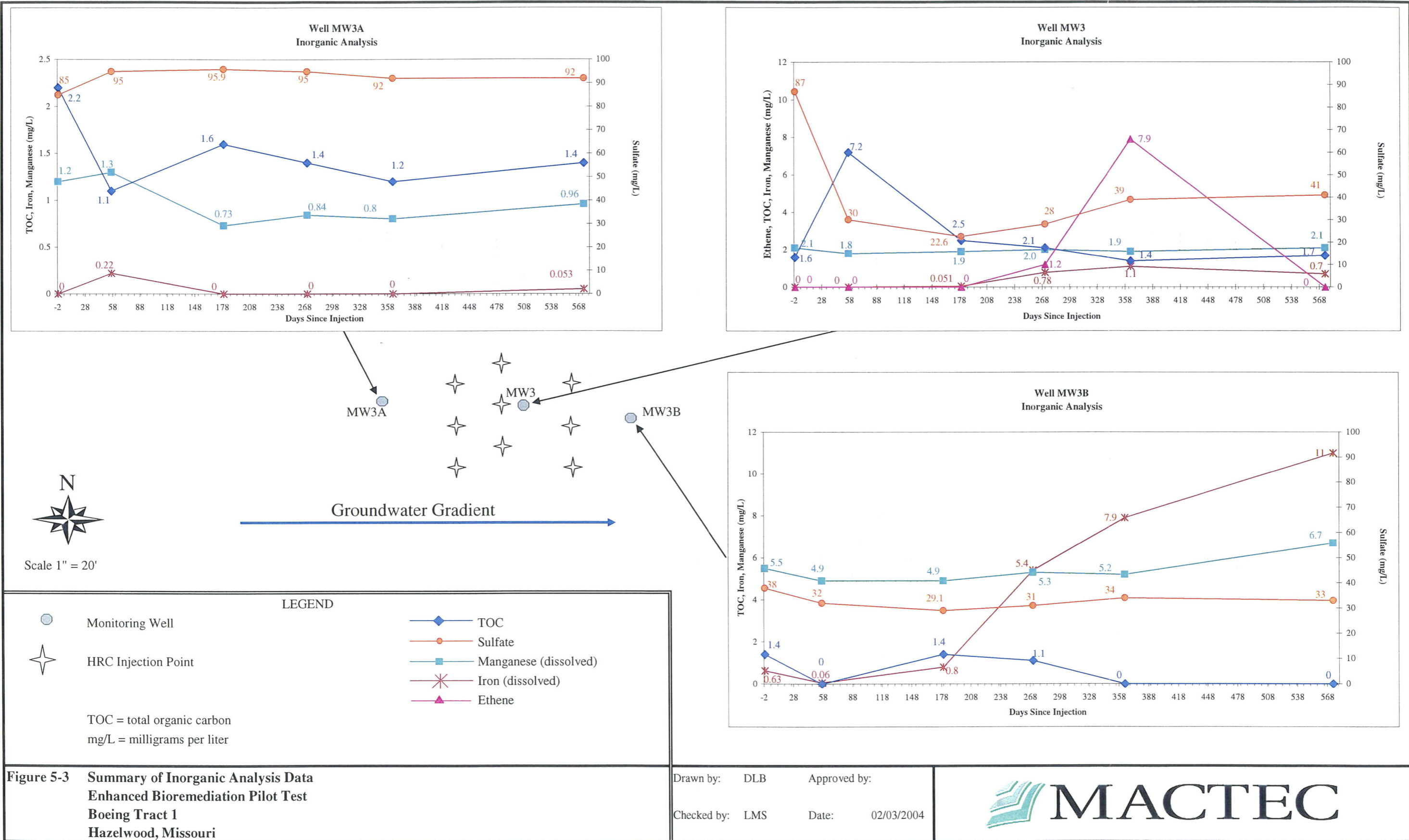
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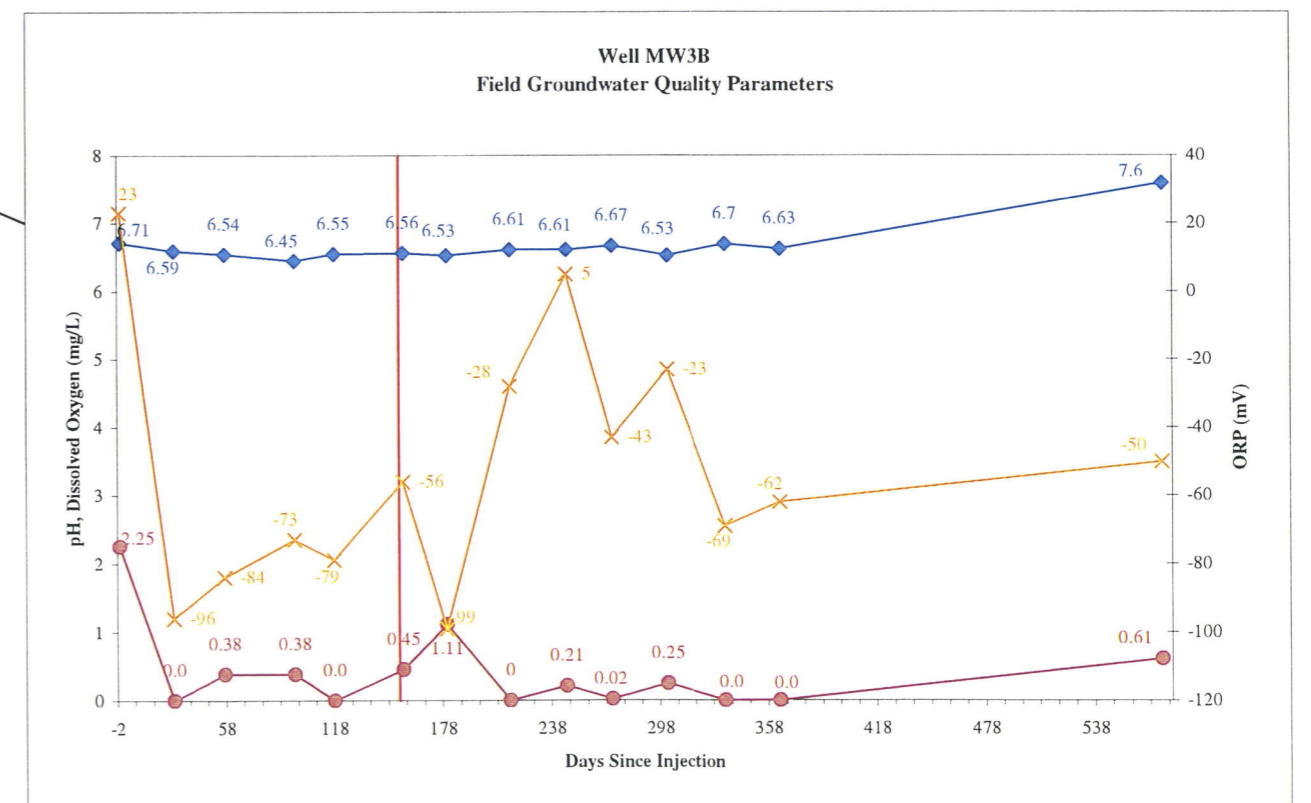
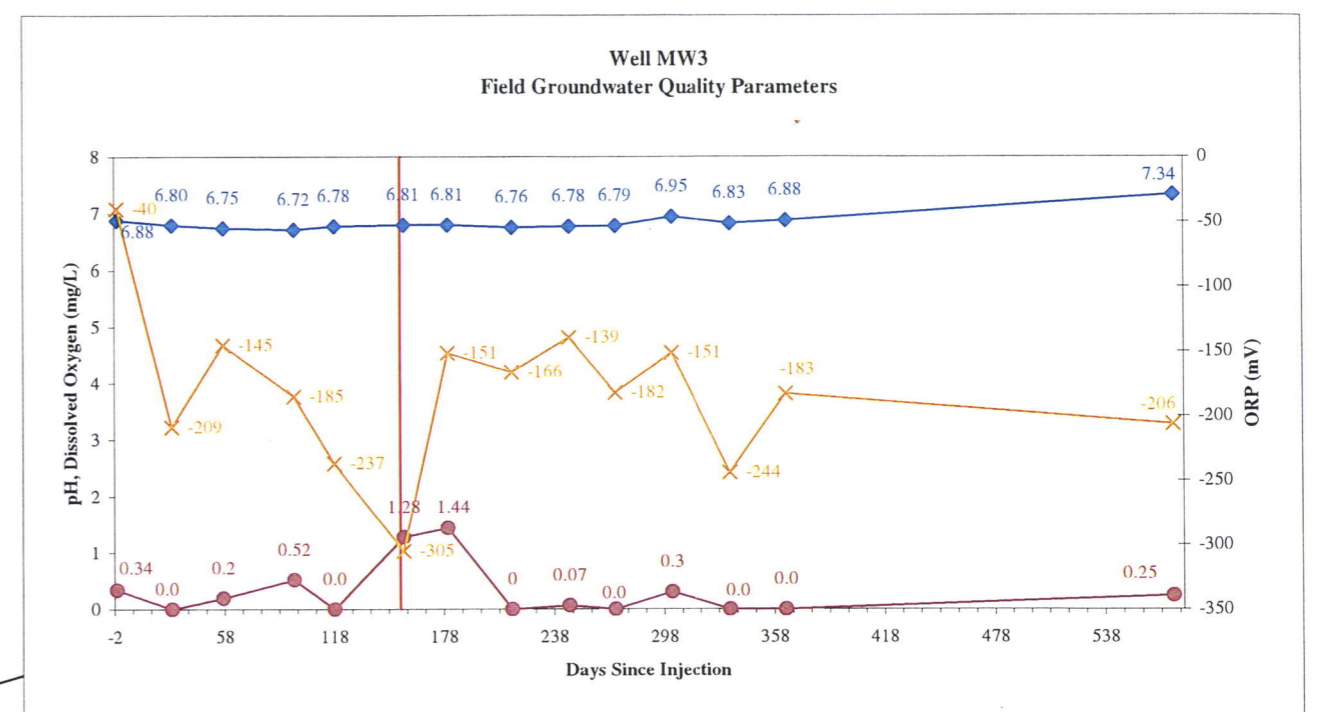
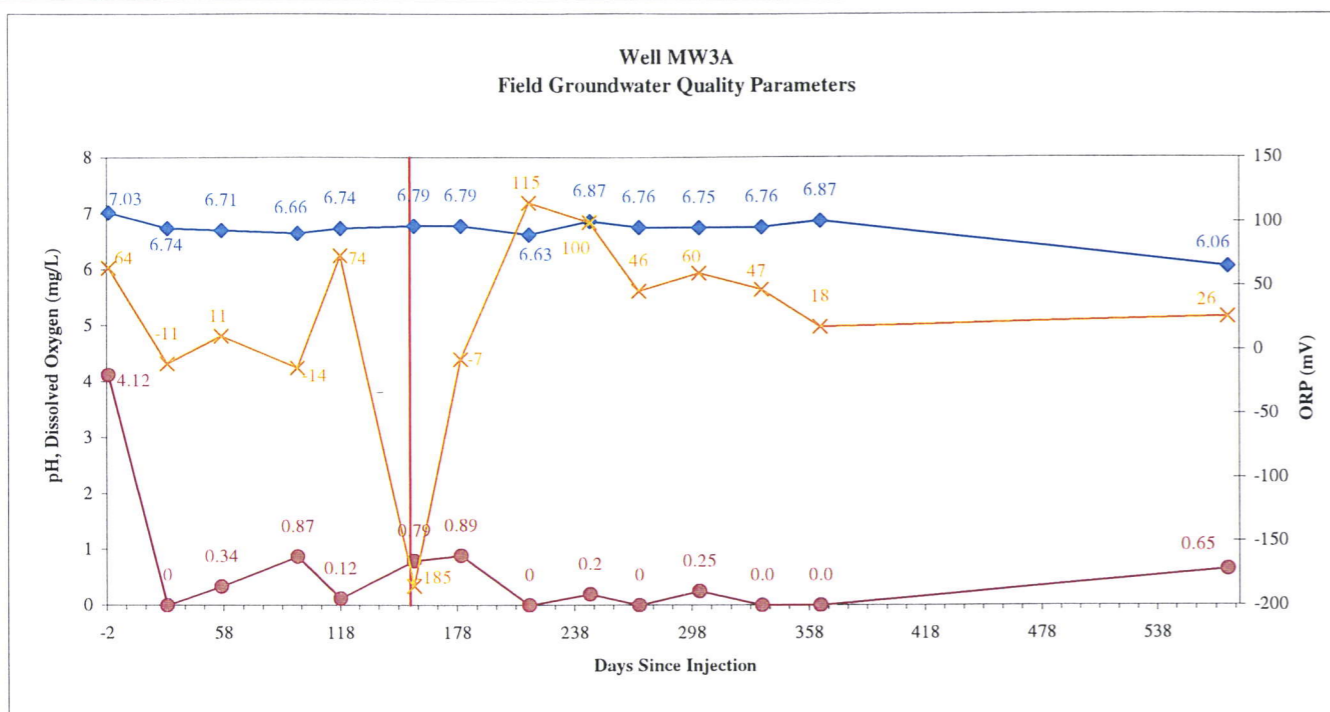
Approved by:

Checked by: LMS

Date: 02/03/2004







Scale 1" = 20'

Groundwater Gradient

MW3A

MW3

MW3B

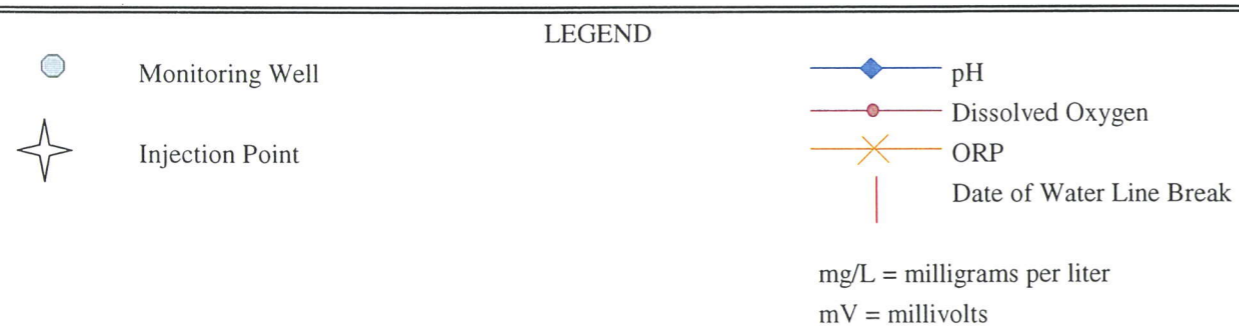


Figure 5-4 Summary of Field Parameter Data
Enhanced Bioremediation Pilot Test
Boeing Tract 1
Hazelwood, Missouri

Drawn by: DLB

Approved by:

Checked by: LMS

Date: 02/03/2004



Appendix A

Boring and Monitoring Well Logs





Well Log

Client: Boeing	Location: Tract 1 North	Boring # MW3
Logged By: D. Brinkley	Project # 510098	
Drilled By: Roberts Environmental	Date: 07/19/2000	
Drilling Method: Hollow Stem Auger	Sheet: 1 of 1	
Sampling Method: 5' CME Continuous		
Hole Diameter: 8.5 inch		

Field Location:



Depth (ft)	Graphic Log	Sampler Location	Sample Recovery	Analyses/Tests		Time	USCS Symbol	Well Construction: 2" sch 40 PVC, 0.001" slot screen	
				PID (ppm)	Lab Sample ID			Screen Interval:	
								19.7	to 9.7
								Sand Pack:	19.7 to 7.5
								Seal:	8 ft. to 2 ft.
								Description:	2" asphalt, 8" concrete pavement. No rock base below concrete.
				3	MW-3-2		cl		silty clay, moderate plasticity, grayish olive, soft, slightly moist, no odor
			36"						
5				3		1505			
							cl		Silty clay, high plasticity, ducky yellowish brown, soft, some iron staining, no odor
				2					
			36"						
10				5		1515			
				4			cl		Silty clay, grayish olive, moderate to high plasticity, moist, stiff, no odor
			60"						
15						1530			
				5					
							cl		as above, very stiff, wet
20			60"	2		1540			

		<h1>Well Log</h1>		Client: Boeing	Location: Tract 1 North	Boring # MW3A		
				Logged By: D. Brinkley	Project # 510098			
Field Location: <div>  </div>				Drilled By: Roberts Environmental	Date: 06/10/2003			
				Drilling Method: Hollow Stem Auger				
				Sampling Method: 5' CME Continuous	Sheet: 1 of 1			
				Hole Diameter: 8.5 inch				
Depth (ft)	Graphic Log	Sampler Location	Sample Recovery	Analyses/Tests		Time	USCS Symbol	Well Construction:
				PID (ppm)	Lab Sample ID			2" sch 40 PVC, 0.001" slot screen
						0840		Screen Interval: 20 ft. to 5 ft.
								Sand Pack: 20.5 ft. to 3 ft.
								Seal: 3 ft. to 1 ft.
								Description: 8" concrete pavement
				1				
							cl	Silty clay, moderate plasticity, grayish olive, soft, slightly moist, no odor, lots of iron staining and root scars
			36"	5				
5								
				4				As above, becoming moist to wet, dusky yellowish brown, moderate to high plasticity, some iron staining, no odor
				0		0855		
			48"				cl	
10				1				Color change at 10' to grayish olive, moderate to high plasticity, three long root traces 8" long, vertical at 9' to 10', iron oxidized inside but open up to 0.25"
				2				
						0905		
			60"					
15				1				
							cl	
								Silty clay, grayish olive, moderate to high plasticity, stiff, moist to wet
				1				
			60"			0910		
			60"	1				as above
20			6"					

Well Log

Client: Boeing	Location: Tract 1 North	Boring # MW3B
Logged By: D. Brinkley		Project # 510098
Drilled By: Roberts Environmental	Date:	
Drilling Method: Hollow Stem Auger	06/10/2003	
Sampling Method: 5' CME Continuous	Sheet:	
Hole Diameter: 8.5 inch	1 of 1	

Field Location:

[illegible]

Appendix B

Underground Injection Control Permit

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
MISSOURI CLEAN WATER COMMISSION



MISSOURI STATE OPERATING PERMIT

UNDERGROUND INJECTION CONTROL

Permit No. UI-0000020

Owner: Boeing Company
Address: PO Box 516, St. Louis, MO 63166

Continuing Authority: Same as above
Address: Same as above

Facility Name: Boeing Fabrication Facility (Former)
Facility Address: 142 J.S. McDonnell Blvd., Hazelwood, MO 63042

Legal Description: NW ¼, NW ¼, Sec. 5, T46N, R6E, St. Louis

Receiving Stream: Unnamed Tributary to Coldwater Creek (U)
First Classified Stream and ID: Coldwater Creek (C) (01706)
USGS Basin & Sub-watershed No.: (10300200-180002)

FACILITY DESCRIPTION

Underground Injection - SIC #7389

Direct push borings to inject about 5,000 pounds of Hydrogen Release Compound, which is a lactic acid producing mixture, to a depth of about 30 feet to remediate chlorinated solvents that are present in the subsurface.

April 19, 2002
Effective Date

April 18, 2007
Expiration Date
MO 780-0041 (10-93)

Stephen M. Mahford, Director, Department of Natural Resources
Executive Secretary, Clean Water Commission

Interim Director of Staff, Clean Water Commission

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

PERMIT NUMBER UI-0000020

The permittee is authorized to discharge from outfall(s) with serial number(s) as specified in the application for this permit. The final effluent limitations shall become effective upon issuance and remain in effect until expiration of the permit. Such discharges shall be controlled, limited and monitored by the permittee as specified below:

OUTFALL NUMBER AND EFFLUENT PARAMETER(S)	UNITS	FINAL EFFLUENT LIMITATIONS			MONITORING REQUIREMENTS	
		DAILY MAXIMUM	WEEKLY AVERAGE	MONTHLY AVERAGE	MEASUREMENT FREQUENCY	SAMPLE TYPE
<u>Preproject Monitoring</u>						
pH - Units	SU	**		**	once before project begins	grab
Trichloroethylene (TCE)	mg/L	*		*	once before project begins	grab
<u>Postproject Monitoring</u>						
pH - Units	SU	**		**	once after projects completed	grab
Trichloroethylene (TCE)	mg/L	*		*	once after projects completed	grab
Lactic Acid	mg/L	*			once after projects completed	grab
Total Pounds Chemical Injected	lbs				once after projects completed	report

MONITORING REPORTS SHALL BE SUBMITTED as outlined above; THE FIRST REPORT IS DUE as outlined above. THERE SHALL BE NO DISCHARGE OF FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

B. STANDARD CONDITIONS

IN ADDITION TO SPECIFIED CONDITIONS STATED HEREIN, THIS PERMIT IS SUBJECT TO THE ATTACHED Part I STANDARD CONDITIONS DATED October 1, 1980, AND HEREBY INCORPORATED AS THOUGH FULLY SET FORTH HEREIN.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

- * Monitoring requirement only.
- ** pH is measured in pH units and is not to be averaged. The pH is limited to the range of 6.0-9.0 pH units.

C. SPECIAL CONDITIONS

1. This permit does not allow for the surface discharge of any water. If permittee desires to discharge water to the surface, an NPDES State Operating Permit must first be obtained.

STANDARD CONDITIONS FOR UNDERGROUND INJECTION CONTROL PERMIT

GENERAL CONDITIONS

SECTION A - MONITORING AND REPORTING

1. Representative Sampling

- a. Samples and measurements taken as required herein shall be representative of the nature and volume.
- b. Monitoring results shall be recorded and reported, postmarked no later than the 28th day of the month following the completed reporting period. Signed copies of these, and all other reports required herein, shall be submitted to the appropriate regional office and the Division of Geology and Land Survey, P.O. Box 250, Rolla, Missouri 65401.

2. Definitions

Definitions as set forth in the Missouri Clean Water Law and Missouri Clean Water Commission Definition Regulation 10 CSR 20-2.010 shall apply to terms used herein.

3. Test Procedures

Test procedures for the analysis of pollutants shall be in accordance with the Missouri Clean Water Commission Effluent Regulation 10 CSR 20-7.015.

4. Recording of Results

- a. For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:
 - i. The date, exact place, and time of sampling or measurements;
 - ii. The individual(s) who performed the sampling or measurements;
 - iii. The date(s) analyses were performed;
 - iv. The individual(s) who performed the analyses;
 - v. The analytical techniques or methods used; and
 - vi. The results of such analyses.
- b. The Federal Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than \$10,000 per violation, or by imprisonment for not more than 6 months per violation, or both.
- c. Calculations of all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Director in the permit.

5. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Monitoring Report Form. Such increased frequency shall also be indicated.

6. Records Retention

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application. This period may be extended by request of the Department at any time.

SECTION B - MANAGEMENT REQUIREMENTS

1. Noncompliance Notification

- a. If, for any reason, the permittee does not comply with or will be unable to comply with any daily maximum limitation specified in this permit, the permittee shall provide the Department with the following information, in writing within five (5) days of becoming aware of such condition:
 - i. A description of the violation and cause of noncompliance, and
 - ii. The period of noncompliance, including exact dates and times or, if not corrected, that anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the noncompliance.
- b. Twenty-four hour reporting. The permittee shall report any noncompliance, which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The Department may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

2. Facilities Operation

Permittees shall operate and maintain facilities to comply with the Missouri Clean Water Law and applicable permit conditions.

3. Adverse Impact

The permittee shall take all necessary steps to minimize any adverse impact to waters of the state resulting from noncompliance with any limitations specified in this permit or set forth in the Missouri Clean Water Law and Regulations (hereinafter the Law and Regulations), including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

4. Removed Substances

Solids, sludge, filter backwash, or other pollutants removed in the course of treatment or control of waters shall be disposed of in a manner such as to prevent any pollutants from entering waters of the state unless permitted by the Law, and a permanent record of the date and time, volume and methods of removal and disposal of such substances shall be maintained by the permittee.

5. Right of Entry

For the purpose of inspecting, monitoring, or sampling the injection wells, point source, water contaminant source, or wastewater treatment facility for compliance with the Clean Water Law and these regulations, authorized representatives of the Department shall be allowed by the permittee, upon presentation of credentials and at reasonable times:

- a. to enter upon permittee's premises in which an injection well, point source, water contaminant source, or wastewater treatment facility is located or in which any records are required to be kept under terms and conditions of the permit;
- b. to have access to, or copy any records required to be kept under terms and conditions of the permit;
- c. to inspect any monitoring equipment or method required in the permit;
- d. to inspect any collection, treatment, or discharge facility covered under the permit; and
- e. to sample any wastewater at any point in the collection system or treatment process.

SECTION B - MANAGEMENT REQUIREMENTS (continued)

6. Permits Transferable

- a. Subject to section (3) of 10 CSR 20-6.010 an operating permit may be transferred upon submission to the Department of an application to transfer signed by a new owner. Until such time as the permit is officially transferred, the original permittee remains responsible for complying with the terms and conditions of the existing permit.
- b. The Department, within thirty (30) days of receipt of the application shall notify the new permittee of its intent to revoke and reissue or transfer the permit.

7. Availability of Reports

Except for data determined to be confidential under the Missouri Clean Water Commission Regulation for Public Participation, Hearings and Notice to Governmental Agencies 10 CSR 20-6.020, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department. As required by statute, operating data shall be subject to the imposition of criminal penalties as provided for in Section 644.076 of the Law.

8. Permit Modifications

- a. Subject to compliance with statutory requirements of the Law and Regulations and applicable Court Order, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:
 - i. violation of any terms or conditions of this permit or the Law;
 - ii. having obtained this permit by misrepresentation or failure to disclose fully all relevant facts;
 - iii. a change in any circumstances or conditions that requires either a temporary or permanent reduction or elimination of the authorized discharge, or
 - iv. any reason set forth in the Law and Regulations.

9. Civil and Criminal Liability

Except as authorized by statute nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

10. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state statute or regulations.

11. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of or violation of federal, state or local laws or regulations.

12. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for a new permit 180 days prior to expiration of this permit.

SECTION B - MANAGEMENT REQUIREMENTS (continued)

13. Signatory Requirement

All reports or information submitted to the Director shall be signed.

14. Rights Not Affected

Nothing in this permit shall affect the permittee's right to appeal or seek a variance from applicable laws or regulations as allowed by law.

15. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

Appendix C

Analytical Laboratory Reports and Chain-of-Custody Forms

ANALYTICAL REPORT

November 19, 2001

Page 1 of 1

Work Order: 11J1098

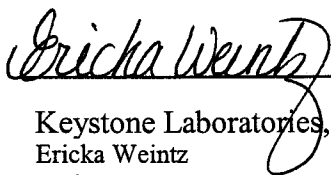
Report To
Doug Marian Harding ESE 3199 River Port Tech Center St. Louis, MO 63043

Work Order Information
Date Received: 10/26/2001 11:05AM Collector: Collector Phone: 314-567-4600 PO Number:

Project: Boeing/GKN
Project Number: Boeing

Analyte	Result	MRL	Method	Analyst	Analyzed	Qualifier
11J1098-01	MW3W		Matrix: Water		Collected: 10/25/01 15:55	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	FIZ	11/16/01 9:47	

End of Report



Keystone Laboratories, Inc.
Ericka Weintz
Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.



11665 Lilburn Park Road, St. Louis, MO 63146-3535
Telephone: (314) 567-4600 -- Fax: (314) 567-5030

FOR LAB USE ONLY

Project Number: _____

1151098 0078

Chain of Custody Record

Client: HARDING BE
Address: 3199 RIVERPORT TECH CENTER
ST LOUIS MO 63043
Phone #: (314) 209-5900 Fax #: (314) 209-5929
P.O. #: _____
Client Contact: DOUG MARION
Project # / Location: BOENG / GKN

Sample Type: **Container Type:**

1. Water
2. Soil
3. Sludge
4. Oil
5. Tissue
- Other :

P - Plastic
G - Glass
V - VOC

Preservative:

1. None
2. H_2SO_4
3. HNO_3
4. NaOH
5. HCl

LACTIC ACID

Analyses

pH
Specific Conductivity
Temperature

Comments

[illegible]

Relinquished By:

Date: 10-25-01
Time: 17:25

Received By:

Date: -- --

Time: _____

Relinquished By:

Date: -- --
Time: :

Received For Lab By:

Date: 10-26 --01

Time: 11:05

FOR LAB USE ONLY

Samples Received Chilled

☐ Yes ☐ No

SPECIAL INSTRUCTIONS:

PRESERVE ASAP

Copies: White - Client Canary - Lab Receiving Pink - Lab File Goldenrod - Retained by Sampler

Accreditations:
Iowa DNR: 095
New Jersey DEP: IA001
Kansas DHE: E-10287

ANALYTICAL REPORT

September 25, 2002

Page 1 of 2

Work Order: 12F0702

Report To
Dennis Brinkley
Harding ESE - MO
3199 River Port Tech Center
St. Louis, MO 63043

Work Order Information
Date Received: 06/20/2002 10:00AM
Collector: Friesner, Jack
Phone: 314-567-4600
PO Number:

Project: Boeing/GKN
Project Number: Boeing

Analyte	Result	MRL	Method	Analyst	Analyzed	Qualifier
12F0702-01	MW3W		Matrix: Water		Collected: 06/19/02 08:30	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	HPLC/UV	JLH	06/26/02 23:24	
Lactic Acid (C3)	26.6 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:24	
Lactic Acid (C3)	26.6 mg/l	1.0	HPLC/UV	GGD	06/26/02 23:24	
Acetic Acid (C2)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:24	
Propionic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:24	
Butyric Acid (C4)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:24	
12F0702-02	MW3AW		Matrix: Water		Collected: 06/19/02 17:45	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	HPLC/UV	JLH	06/26/02 23:45	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:45	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	GGD	06/26/02 23:45	
Acetic Acid (C2)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:45	
Propionic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:45	
Butyric Acid (C4)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:45	
12F0702-03	MW3BW		Matrix: Water		Collected: 06/19/02 15:00	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	HPLC/UV	JLH	06/27/02 0:06	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	GGD	06/27/02 0:06	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/27/02 0:06	
Acetic Acid (C2)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/27/02 0:06	
Propionic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/27/02 0:06	
Butyric Acid (C4)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/27/02 0:06	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL = Method Reporting Limit.

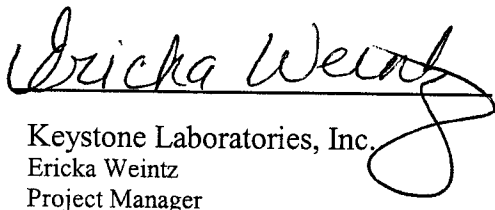
Harding ESE - MO
3199 River Port Tech Center
St. Louis, MO 63043

Work Order: 12F0702

September 25, 2002

Page 2 of 2

End of Report


Keystone Laboratories, Inc.
Ericka Weintz
Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL = Method Reporting Limit.

Keystone

LABORATORIES, INC.

☒ 600 E. 17th St. S.
 Newton, IA 50208
 Phone: 641-792-8451
 Fax: 641-792-7989

☐ 3012 Ansborough Ave.
 Waterloo, IA 50701
 Phone: 319-235-4440
 Fax: 319-235-2480

☐ 1304 Adams
 Kansas City, KS 66103
 Phone: 913-321-7856
 Fax: 913-321-7937

PAGE _____ OF _____

PRINT OR TYPE INFORMATION BELOW SAMPLER: <u>JACK E FRIESNER</u> SITE NAME: <u>BOEING/AGKN</u> ADDRESS: _____ CITY/ST/ZIP: <u>ST LOUIS MO</u> PHONE: _____	REPORT TO: NAME: <u>DENNIS BRINKLEY</u> COMPANY NAME: <u>HARDING ESE</u> ADDRESS: <u>3199 Riverport Tech Center Dr.</u> CITY/ST/ZIP: <u>MARYLAND HEIGHTS MO 63129</u> PHONE: <u>(314) 209-5900</u> FAX: <u>(314) 209-5927</u>	BILL TO: NAME: _____ COMPANY NAME: <u>HARDING ESE</u> ADDRESS: _____ CITY/ST/ZIP: _____ PHONE: _____ Keystone Quote No.: _____ (If Applicable)
--	---	--

CLIENT SAMPLE NUMBER	DATE	TIME	SAMPLE LOCATION	NO. OF CONTAINERS	MATRIX	GRAB/COMPOSITE	Metabolic Acids	ANALYSES REQUIRED								LAB USE ONLY			
																		LABORATORY WORK ORDER NO.	LABORATORY SAMPLE NUMBER
																		SAMPLE TEMPERATURE UPON RECEIPT: <div>°C</div>	
SAMPLE CONDITION/COMMENTS																			
MW3W	6/19/02	0830		1	GW		X									01			
MW3AW	6/18/02	1745		1	GW		X									02			
MW3BW	6/18/02	1500		1	GW		X									03			
													</						

Relinquished by: (Signature) 	Date <u>6/19/02</u>	Received by: (Signature) 	Date _____	Turn-Around: <input checked="" type="checkbox"/> Standard <input type="checkbox"/> Rush _____ Contact Lab Prior to Submission
Relinquished by: (Signature) 	Date <u>1730</u>	Received for Lab by: (Signature) 	Date <u>6/20/02</u>	Remarks: _____
	Time _____		Time <u>10:00</u>	

Accreditations:
Iowa DNR: 095
New Jersey DEP: IA001
Kansas DHE: E-10287

ANALYTICAL REPORT

October 10, 2002

Work Order: 12I0812

Page 1 of 3

Report To

Dennis Brinkley
Harding ESE - MO
3199 River Port Tech Center
St. Louis, MO 63043

Work Order Information

Date Received: 09/24/2002 10:40AM
Collector:
Phone: 314-567-4600
PO Number:

Project : Boeing/GKN
Project Number: Boeing

Analyte	Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
12I0812-01 MW3A				Matrix: Water		Collected: 09/23/02 07:15	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1J20820	HPLC/UV	JLH	10/07/02 20:19	
Lactic Acid (C3)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:19	
Acetic Acid (C2)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:19	
Propionic Acid (C3)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:19	
Butyric Acid (C4)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:19	
12I0812-02 MW3				Matrix: Water		Collected: 09/23/02 08:20	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1J20820	HPLC/UV	JLH	10/07/02 20:47	
Lactic Acid (C3)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:47	
Acetic Acid (C2)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:47	
Propionic Acid (C3)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:47	
Butyric Acid (C4)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:47	
12I0812-03 MW3B				Matrix: Water		Collected: 09/19/02 14:40	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1J20820	HPLC/UV	JLH	10/07/02 21:15	
Lactic Acid (C3)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 21:15	
Acetic Acid (C2)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 21:15	
Propionic Acid (C3)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 21:15	
Butyric Acid (C4)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 21:15	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL = Method Reporting Limit.

Harding ESE - MO
3199 River Port Tech Center
St. Louis, MO 63043

October 10, 2002

Work Order: 12I0812

Page 2 of 3

Determination of Metabolic Acids - Quality Control

Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1J20820 - General Prep HPLC/IC										
Blank (1J20820-BLK1)				Prepared & Analyzed: 10/07/02						
Pyruvic Acid (C3)	ND	0.1	mg/l							
Lactic Acid (C3)	ND	1.0	"							
Acetic Acid (C2)	ND	1.0	"							
Propionic Acid (C3)	ND	1.0	"							
Butyric Acid (C4)	ND	1.0	"							
LCS (1J20820-BS1)				Prepared & Analyzed: 10/07/02						
Pyruvic Acid (C3)	55.00	0.1	mg/l	56.70		97.0	66-134			
Lactic Acid (C3)	237.3	1.0	"	198.9		119	68-138			
Acetic Acid (C2)	149.7	1.0	"	150.8		99.3	73-122			
Propionic Acid (C3)	156.7	1.0	"	156.0		100	77-120			
Butyric Acid (C4)	146.7	1.0	"	146.4		100	75-119			
Matrix Spike (1J20820-MS1)				Source: 12I0814-01		Prepared & Analyzed: 10/07/02				
Pyruvic Acid (C3)	46.34	0.1	mg/l	37.80	ND	123	58-127			
Lactic Acid (C3)	182.5	1.0	"	132.6	ND	138	58-132			QM-05
Acetic Acid (C2)	117.3	1.0	"	100.6	ND	117	65-128			
Propionic Acid (C3)	133.3	1.0	"	104.0	ND	128	64-128			
Butyric Acid (C4)	108.6	1.0	"	97.60	ND	111	67-127			
Matrix Spike Dup (1J20820-MSD1)				Source: 12I0814-01		Prepared & Analyzed: 10/07/02				
Pyruvic Acid (C3)	45.87	0.1	mg/l	37.80	ND	121	58-127	1.02	28	
Lactic Acid (C3)	185.9	1.0	"	132.6	ND	140	58-132	1.85	29	QM-05
Acetic Acid (C2)	120.5	1.0	"	100.6	ND	120	65-128	2.69	31	
Propionic Acid (C3)	134.6	1.0	"	104.0	ND	129	64-128	0.971	28	QM-05
Butyric Acid (C4)	113.2	1.0	"	97.60	ND	116	67-127	4.15	26	

ND = Non Detect; REC= Recovery; RPD= Relative Percent Difference

Notes and Definitions

QM-05 The spike recovery was outside acceptance limits for the MS and/or MSD due to matrix interference. The LCS and/or LCSD were within acceptance limits showing that the laboratory is in control and the data is acceptable.

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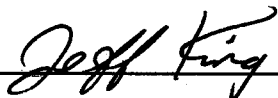
Harding ESE - MO
3199 River Port Tech Center
St. Louis, MO 63043

October 10, 2002

Work Order: 12I0812

Page 3 of 3

End of Report



Keystone Laboratories, Inc.
Ericka Weintz
Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.



FOR LAB USE ONLY

Project Number:

1210812

0099

Chain of Custody Record

Project # / Location: BOEING / GKN

Sample Type: **Container Type:**

1. Water
 2. Soil
 3. Sludge
 4. Oil
 5. Tissue
- Other :

Container Type:

- P - Plastic
G - Glass
V - VOC

Preservative:

1. None 4. NaOH
2. H_2SO_4 5. HCl
3. HNO_3 6. Phosphoric

Analyses

[illegible]

SPECIAL INSTRUCTIONS:

Copies: White - Client Canary - Lab Receiving Pink - Lab File Goldenrod - Retained by Sampler

Accreditations:
Iowa DNR: 095
New Jersey DEP: IA001
Kansas DHE: E-10287

ANALYTICAL REPORT

January 08, 2003

Work Order: 12L0584

Page 1 of 1

Report To

Dennis Brinkley
MACTEC (Harding ESE)
3199 River Port Tech Center
St. Louis, MO 63043

Work Order Information

Date Received: 12/17/2002 10:04AM
Collector: Friesner, Jack
Phone: 314-567-4600
PO Number:

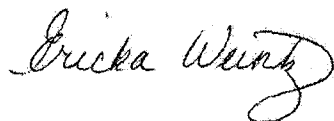
Project: Boeing/GKN
Project Number: Boeing/GKN

Analyte	Result	MRL	Method	Analyst	Analyzed	Qualifier
12L0584-01	MW3BW		Matrix: Water		Collected: 12/16/02 13:55	
Pyruvic Acid (C3)	<0.2 mg/l	0.2	HPLC/UV	JLH	01/07/03 10:20	R-01
Lactic Acid (C3)	<2.0 mg/l	2.0	HPLC/UV	JLH	01/07/03 10:20	R-01
Acetic Acid (C2)	<2.0 mg/l	2.0	HPLC/UV	JLH	01/07/03 10:20	R-01
Propionic Acid (C3)	<2.0 mg/l	2.0	HPLC/UV	JLH	01/07/03 10:20	R-01
Butyric Acid (C4)	<2.0 mg/l	2.0	HPLC/UV	JLH	01/07/03 10:20	R-01
12L0584-02	MW3W		Matrix: Water		Collected: 12/16/02 15:05	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	HPLC/UV	JLH	01/06/03 15:12	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	01/06/03 15:12	
Acetic Acid (C2)	<1.0 mg/l	1.0	HPLC/UV	JLH	01/06/03 15:12	
Propionic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	01/06/03 15:12	
Butyric Acid (C4)	<1.0 mg/l	1.0	HPLC/UV	JLH	01/06/03 15:12	
12L0584-03	MW3AW		Matrix: Water		Collected: 12/16/02 16:35	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	HPLC/UV	JLH	01/06/03 15:34	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	01/06/03 15:34	
Acetic Acid (C2)	<1.0 mg/l	1.0	HPLC/UV	JLH	01/06/03 15:34	
Propionic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	01/06/03 15:34	
Butyric Acid (C4)	<1.0 mg/l	1.0	HPLC/UV	JLH	01/06/03 15:34	

Notes and Definitions

R-01 The Reporting Limit for this analyte has been raised to account for matrix interference.

End of Report



Keystone Laboratories, Inc.

Ericka Weintz
Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL = Method Reporting Limit.

Keystone

LABORATORIES, INC.

☒ 600 E. 17th St. S.
Newton, IA 50208
Phone: 641-792-8451
Fax: 641-792-7989

☐ 3012 Ansborough Ave.
Waterloo, IA 50701
Phone: 319-235-4440
Fax: 319-235-2480

☐ 1304 Adams
Kansas City, KS 66103
Phone: 913-321-7856
Fax: 913-321-7937

PAGE 1 OF 1

PRINT OR TYPE INFORMATION BELOW

SAMPLER: JACK E FRIESWORTH

SITE NAME: BOEING/GEN

ADDRESS: _____

CITY/ST/ZIP: _____

PHONE: _____

REPORT TO:

NAME: DENNIS BRINKLEY

COMPANY NAME: MACTEC

ADDRESS: 3199 RIVERPORT TECH Center Dr.

CITY/ST/ZIP: ST LOUIS MO 63043

PHONE: (314) 209-5900

FAX: (314) 209-5929

BILL TO:

NAME: DENNIS BRINKLEY

COMPANY NAME: MACTEC

ADDRESS: 3199 RIVERPORT TECH Center Dr.

CITY/ST/ZIP: ST LOUIS MO 63043

PHONE: (314) 209-5900

Keystone Quote No.: _____

(If Applicable)

CLIENT SAMPLE NUMBER	DATE	TIME	SAMPLE LOCATION	NO. OF CONTAINERS	MATRIX	GRAB/COMPOSITE	ANALYSES REQUIRED										LAB USE ONLY	
							Metabolic Analysis										LABORATORY WORK ORDER NO.	LABORATORY SAMPLE NUMBER
MW3BW	12/16/02	1355		1	GW		X										1210584	01
MW3W	12/16/02	1505		1	GW		X											02
MW3AW	12/16/02	1635		1	GW		X											03

Relinquished by: (Signature) [Signature]

Date: 12/16/02

Time: 1730

Relinquished by: (Signature) _____

Date: _____

Time: _____

Received by: (Signature) _____

Received for Lab by: (Signature) _____

Date: _____

Time: _____

Date: _____

Time: _____

Turn-Around:

☒ Standard

☐ Rush

Contact Lab Prior to Submission

Remarks: _____

Accreditations:
Iowa DNR: 095
New Jersey DEP: 1A001
Kansas DHE: E-10287

ANALYTICAL REPORT

March 20, 2003

Work Order: 13C0609

Page 1 of 1

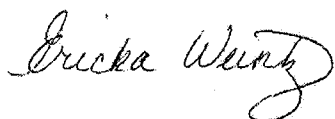
Report To
Dennis Brinkley MACTEC (Harding ESE) 3199 River Port Tech Center St. Louis, MO 63043

Work Order Information
Date Received: 03/18/2003 1:22PM Collector: Phone: 314-567-4600 PO Number:

Project: Boeing/GKN
Project Number: Boeing

Analyte	Result	MRL	Method	Analyst	Analyzed	Qualifier
13C0609-01	MW3BW		Matrix: Water		Collected: 03/17/03 14:05	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	HPLC/UV	JLH	03/18/03 20:31	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:31	
Acetic Acid (C2)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:31	
Propionic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:31	
Butyric Acid (C4)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:31	
13C0609-02	MW3B		Matrix: Water		Collected: 03/17/03 18:15	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	HPLC/UV	JLH	03/18/03 20:52	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:52	
Acetic Acid (C2)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:52	
Propionic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:52	
Butyric Acid (C4)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:52	
13C0609-03	MW3BAW		Matrix: Water		Collected: 03/17/03 16:30	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	HPLC/UV	JLH	03/18/03 21:14	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 21:14	
Acetic Acid (C2)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 21:14	
Propionic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 21:14	
Butyric Acid (C4)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 21:14	

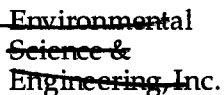
End of Report



Keystone Laboratories, Inc.

Ericka Weintz
Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL = Method Reporting Limit.



0085

Project Number:

13C.0609

Chain of Custody Record

Project # / Location: 510098 | Beijing | 6KW

1. None
2. H_2SO_4
3. HNO_3
4. NaOH
5. HCl

Analyses

METABOLIC ACIDS (TOTAL)

pH
Specific Conductivity
Temperature

Comments

[illegible]

Relinquished By:

Date: 3-17-03

Time: 20 : 00

Received By:

Date: -- --

Time: :

Received For Lab By:

Date: 3-18-03

Time: 13:22

FOR LAB USE ONLY

Samples Received Chilled

☐ Yes☐ No

SPECIAL INSTRUCTIONS:

Copies: White - Client Canary - Lab Receiving Pink - Lab File Goldenrod - Retained by Sampler

Accreditations:
Iowa DNR: 095
New Jersey DEP: 1A001
Kansas DHE: E-10287

ANALYTICAL REPORT

June 26, 2003

Work Order: 13F0789

Page 1 of 3

Report To

Dennis Brinkley
MACTEC E & C - MO
3199 River Port Tech Center
St. Louis, MO 63043

Work Order Information

Date Received: 06/19/2003 9:43AM
Collector: Jack E. Friesney
Phone: 314-567-4600
PO Number:

Project : Boeing/GKN

Project Number: Boeing

Analyte	Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
13F0789-01 MW3BW				Matrix:Water		Collected: 06/18/03 12:30	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1F32535	HPLC/UV	JLH	06/24/03 14:45	
Lactic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 14:45	
Acetic Acid (C2)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 14:45	
Propionic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 14:45	
Butyric Acid (C4)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 14:45	
13F0789-02 MW3AW				Matrix:Water		Collected: 06/18/03 15:10	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1F32535	HPLC/UV	JLH	06/24/03 15:07	
Lactic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 15:07	
Acetic Acid (C2)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 15:07	
Propionic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 15:07	
Butyric Acid (C4)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 15:07	
13F0789-03 MW3W				Matrix:Water		Collected: 06/18/03 16:30	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1F32535	HPLC/UV	JLH	06/24/03 15:57	
Lactic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 15:57	
Acetic Acid (C2)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 15:57	
Propionic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 15:57	
Butyric Acid (C4)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 15:57	

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MACTEC E & C - MO
3199 River Port Tech Center
St. Louis, MO 63043

Work Order: 13F0789

June 26, 2003

Page 2 of 3

Determination of Metabolic Acids - Quality Control

Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1F32535 - General Prep HPLC/IC										
Blank (1F32535-BLK1)				Prepared & Analyzed: 06/24/03						
Pyruvic Acid (C3)	ND	0.1	mg/l							
Lactic Acid (C3)	ND	1.0	"							
Acetic Acid (C2)	ND	1.0	"							
Propionic Acid (C3)	ND	1.0	"							
Butyric Acid (C4)	ND	1.0	"							
LCS (1F32535-BS1)				Prepared & Analyzed: 06/24/03						
Pyruvic Acid (C3)	36.60	0.1	mg/l	36.75		99.6	81-136			
Lactic Acid (C3)	180.4	1.0	"	203.7		88.6	64-134			
Acetic Acid (C2)	166.6	1.0	"	150.7		111	82-122			
Propionic Acid (C3)	169.0	1.0	"	162.4		104	90-112			
Butyric Acid (C4)	155.0	1.0	"	152.4		102	88-113			
Calibration Check (1F32535-CCV1)				Prepared & Analyzed: 06/24/03						
Pyruvic Acid (C3)	29.34	0.1	mg/l	28.00		105	80-120			
Lactic Acid (C3)	94.35	1.0	"	98.94		95.4	80-120			
Acetic Acid (C2)	103.1	1.0	"	91.68		112	80-120			
Propionic Acid (C3)	102.3	1.0	"	94.60		108	80-120			
Butyric Acid (C4)	123.7	1.0	"	114.2		108	80-120			
Calibration Check (1F32535-CCV2)				Prepared & Analyzed: 06/24/03						
Pyruvic Acid (C3)	29.42	0.1	mg/l	28.00		105	80-120			
Lactic Acid (C3)	96.81	1.0	"	98.94		97.8	80-120			
Acetic Acid (C2)	97.84	1.0	"	91.68		107	80-120			
Propionic Acid (C3)	99.95	1.0	"	94.60		106	80-120			
Butyric Acid (C4)	115.5	1.0	"	114.2		101	80-120			
Matrix Spike (1F32535-MS1)				Source: 13F0933-01 Prepared & Analyzed: 06/24/03						
Pyruvic Acid (C3)	26.45	0.1	mg/l	24.50	ND	108	85-149			
Lactic Acid (C3)	129.2	1.0	"	135.8	ND	95.1	61-140			
Acetic Acid (C2)	116.3	1.0	"	100.5	ND	116	68-145			
Propionic Acid (C3)	117.2	1.0	"	108.3	ND	108	76-140			
Butyric Acid (C4)	110.1	1.0	"	101.6	ND	108	79-132			

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MACTEC E & C - MO
3199 River Port Tech Center
St. Louis, MO 63043

Work Order: 13F0789

June 26, 2003

Page 3 of 3

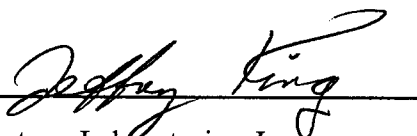
Determination of Metabolic Acids - Quality Control

Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1F32535 - General Prep HPLC/IC										
Matrix Spike Dup (1F32535-MSD1)		Source: 13F0933-01		Prepared & Analyzed: 06/24/03						
Pyruvic Acid (C3)	26.10	0.1	mg/l	24.50	ND	107	85-149	1.33	15	
Lactic Acid (C3)	130.5	1.0	"	135.8	ND	96.1	61-140	1.00	10	
Acetic Acid (C2)	116.6	1.0	"	100.5	ND	116	68-145	0.258	23	
Propionic Acid (C3)	121.5	1.0	"	108.3	ND	112	76-140	3.60	12	
Butyric Acid (C4)	110.7	1.0	"	101.6	ND	109	79-132	0.543	21	

ND = Non Detect; REC= Recovery; RPD= Relative Percent Difference

End of Report



Keystone Laboratories, Inc.
Jeffrey King, Ph.D.
Laboratory Director

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Fax: 913-321-7937

PAGE 1 OF 1



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REPORT OF ANALYSIS

Mr. Dennis Brinkley
MACTEC - St. Louis, MO
3199 Riverport Tech Center Drive
St. Louis, MO 63043

January 20, 2004

Date Received : January 15, 2004
Description : GW - Boeing

Sample ID : MW3AW

Collected By : Jack E Friesner
Collection Date : 01/14/04 14:15

ESC Sample # : L141005-01

Site ID :

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Methane	BDL	1.0	ppm	8015M	01/15/04	1
Chloride	690	5.0	mg/l	9056	01/16/04	5
Nitrate	BDL	0.10	mg/l	9056	01/16/04	1
Nitrite	BDL	0.10	mg/l	9056	01/16/04	1
Sulfate	92.	5.0	mg/l	9056	01/16/04	1
Free Carbon Dioxide	180	20.	mg/l	406B	01/15/04	2
Ethane	BDL	10.	ppm	8015M	01/15/04	1
Ethene	BDL	10.	ppm	8015M	01/15/04	1
DOC	2.6	1.0	mg/l	5310B	01/19/04	1
Sulfide	BDL	0.050	mg/l	9030B	01/16/04	1
TOC (Total Organic Carbon)	1.4	1.0	mg/l	9060	01/15/04	1
Iron	BDL	0.050	mg/l	6010B	01/16/04	1
Iron, Dissolved	0.053	0.050	mg/l	6010B	01/17/04	1
Manganese, Dissolved	0.96	0.010	mg/l	6010B	01/17/04	1
Volatile Organics						
Acetone	BDL	0.050	mg/l	8260B	01/15/04	1
Acrolein	BDL	0.050	mg/l	8260B	01/15/04	1
Acrylonitrile	BDL	0.050	mg/l	8260B	01/15/04	1
Benzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromodichloromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromoform	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
n-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
sec-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
tert-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Carbon tetrachloride	BDL	0.0010	mg/l	8260B	01/15/04	1
Chlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Chlorodibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Chloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



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MACTEC - St. Louis, MO
3199 Riverport Tech Center Drive
St. Louis, MO 63043

Date Received : January 15, 2004
Description : GW - Boeing

Sample ID : MW3AW

Collected By : Jack E Friesner
Collection Date : 01/14/04 14:15

ESC Sample # : L141005-01

Site ID :

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
2-Chloroethyl vinyl ether	BDL	0.050	mg/l	8260B	01/15/04	1
Chloroform	BDL	0.0050	mg/l	8260B	01/15/04	1
Chloromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
2-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
4-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dibromo-3-Chloropropane	BDL	0.0020	mg/l	8260B	01/15/04	1
1,2-Dibromoethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Dibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,4-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Dichlorodifluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloroethene	0.0015	0.0010	mg/l	8260B	01/15/04	1
cis-1,2-Dichloroethene	0.46	0.0010	mg/l	8260B	01/15/04	1
trans-1,2-Dichloroethene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
cis-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
trans-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
2,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
Di-isopropyl ether	BDL	0.0010	mg/l	8260B	01/15/04	1
Ethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Hexachlorobutadiene	BDL	0.0010	mg/l	8260B	01/15/04	1
Isopropylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
p-Isopropyltoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
2-Butanone (MEK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methylene Chloride	BDL	0.0050	mg/l	8260B	01/15/04	1
4-Methyl-2-pentanone (MIBK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methyl tert-butyl ether	BDL	0.0010	mg/l	8260B	01/15/04	1
Naphthalene	BDL	0.0050	mg/l	8260B	01/15/04	1
n-Propylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Styrene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,1,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2-Trichloro-1,2,2-trifluoro	BDL	0.0010	mg/l	8260B	01/15/04	1
Tetrachloroethene	BDL	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



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REPORT OF ANALYSIS

Mr. Dennis Brinkley
MACTEC - St. Louis, MO
3199 Riverport Tech Center Drive
St. Louis, MO 63043

January 20, 2004

Date Received : January 15, 2004
Description : GW - Boeing

Sample ID : MW3AW

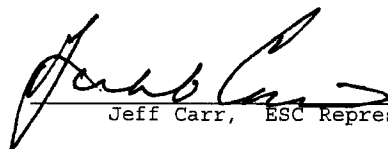
Collected By : Jack E Friesner
Collection Date : 01/14/04 14:15

ESC Sample # : L141005-01

Site ID :

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Toluene	BDL	0.0050	mg/l	8260B	01/15/04	1
1,2,3-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,1-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Trichloroethene	0.29	0.0010	mg/l	8260B	01/15/04	1
Trichlorofluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3,5-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Vinyl chloride	0.013	0.0010	mg/l	8260B	01/15/04	1
Xylenes, Total	BDL	0.0030	mg/l	8260B	01/15/04	1
Surrogate Recovery						
Toluene-d8	98.		% Rec.	8260B	01/15/04	1
Dibromofluoromethane	100		% Rec.	8260B	01/15/04	1
4-Bromofluorobenzene	100		% Rec.	8260B	01/15/04	1


Jeff Carr, ESC Representative

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Note:

The reported analytical results relate only to the sample submitted.

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Reported: 01/20/04 09:23 Printed: 01/20/04 15:02



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REPORT OF ANALYSIS

January 20, 2004

Mr. Dennis Brinkley
MACTEC - St. Louis, MO
3199 Riverport Tech Center Drive
St. Louis, MO 63043

Date Received : January 15, 2004
Description : GW - Boeing

Sample ID : MW3BW

Collected By : Jack E Friesner
Collection Date : 01/14/04 12:35

ESC Sample # : L141005-02

Site ID :

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Methane	BDL	1.0	ppm	8015M	01/15/04	1
Chloride	1400	10.	mg/l	9056	01/16/04	10
Nitrate	BDL	0.10	mg/l	9056	01/16/04	1
Nitrite	BDL	0.10	mg/l	9056	01/16/04	1
Sulfate	33.	5.0	mg/l	9056	01/16/04	1
Free Carbon Dioxide	120	10.	mg/l	406B	01/15/04	1
Ethane	BDL	10.	ppm	8015M	01/15/04	1
Ethene	BDL	10.	ppm	8015M	01/15/04	1
DOC	1.4	1.0	mg/l	5310B	01/19/04	1
Sulfide	BDL	0.050	mg/l	9030B	01/16/04	1
TOC (Total Organic Carbon)	BDL	1.0	mg/l	9060	01/15/04	1
Iron	16.	0.050	mg/l	6010B	01/16/04	1
Iron, Dissolved	11.	0.050	mg/l	6010B	01/17/04	1
Manganese, Dissolved	6.7	0.010	mg/l	6010B	01/17/04	1
Volatile Organics						
Acetone	BDL	0.050	mg/l	8260B	01/15/04	1
Acrolein	BDL	0.050	mg/l	8260B	01/15/04	1
Acrylonitrile	BDL	0.050	mg/l	8260B	01/15/04	1
Benzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromodichloromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromoform	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
n-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
sec-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
tert-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Carbon tetrachloride	BDL	0.0010	mg/l	8260B	01/15/04	1
Chlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Chlorodibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Chloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



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January 20, 2004

Date Received : January 15, 2004
Description : GW - Boeing

ESC Sample # : L141005-02

Sample ID : MW3BW

Site ID :

Collected By : Jack E Friesner
Collection Date : 01/14/04 12:35

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
2-Chloroethyl vinyl ether	BDL	0.050	mg/l	8260B	01/15/04	1
Chloroform	BDL	0.0050	mg/l	8260B	01/15/04	1
Chloromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
2-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
4-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dibromo-3-Chloropropane	BDL	0.0020	mg/l	8260B	01/15/04	1
1,2-Dibromoethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Dibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,4-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Dichlorodifluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloroethene	BDL	0.0010	mg/l	8260B	01/15/04	1
cis-1,2-Dichloroethene	0.0062	0.0010	mg/l	8260B	01/15/04	1
trans-1,2-Dichloroethene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
cis-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
trans-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
2,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
Di-isopropyl ether	BDL	0.0010	mg/l	8260B	01/15/04	1
Ethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Hexachlorobutadiene	BDL	0.0010	mg/l	8260B	01/15/04	1
Isopropylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
p-Isopropyltoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
2-Butanone (MEK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methylene Chloride	BDL	0.0050	mg/l	8260B	01/15/04	1
4-Methyl-2-pentanone (MIBK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methyl tert-butyl ether	BDL	0.0010	mg/l	8260B	01/15/04	1
Naphthalene	BDL	0.0050	mg/l	8260B	01/15/04	1
n-Propylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Styrene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,1,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2-Trichloro-1,2,2-trifluoro	BDL	0.0010	mg/l	8260B	01/15/04	1
Tetrachloroethene	BDL	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



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Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

January 20, 2004

Mr. Dennis Brinkley
MACTEC - St. Louis, MO
3199 Riverport Tech Center Drive
St. Louis, MO 63043

Date Received : January 15, 2004
Description : GW - Boeing

Sample ID : MW3BW

Collected By : Jack E Friesner
Collection Date : 01/14/04 12:35

ESC Sample # : L141005-02

Site ID :

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Toluene	BDL	0.0050	mg/l	8260B	01/15/04	1
1,2,3-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,1-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Trichloroethene	BDL	0.0010	mg/l	8260B	01/15/04	1
Trichlorofluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3,5-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Vinyl chloride	0.0018	0.0010	mg/l	8260B	01/15/04	1
Xylenes, Total	BDL	0.0030	mg/l	8260B	01/15/04	1
Surrogate Recovery						
Toluene-d8	100		% Rec.	8260B	01/15/04	1
Dibromofluoromethane	100		% Rec.	8260B	01/15/04	1
4-Bromofluorobenzene	100		% Rec.	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Note:

The reported analytical results relate only to the sample submitted.

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Reported: 01/20/04 09:23 Printed: 01/20/04 15:02

Jeff Carr, ESC Representative



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REPORT OF ANALYSIS

Mr. Dennis Brinkley
MACTEC - St. Louis, MO
3199 Riverport Tech Center Drive
St. Louis, MO 63043

January 20, 2004

Date Received : January 15, 2004
Description : GW - Boeing

ESC Sample # : L141005-03

Sample ID : MW3W

Site ID :

Collected By : Jack E Friesner
Collection Date : 01/14/04 16:30

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Methane	1.6	1.0	ppm	8015M	01/15/04	1
Chloride	480	5.0	mg/l	9056	01/16/04	5
Nitrate	BDL	0.10	mg/l	9056	01/16/04	1
Nitrite	BDL	0.10	mg/l	9056	01/16/04	1
Sulfate	41.	5.0	mg/l	9056	01/16/04	1
Free Carbon Dioxide	140	50.	mg/l	406B	01/15/04	5
Ethane	BDL	10.	ppm	8015M	01/15/04	1
Ethene	BDL	10.	ppm	8015M	01/15/04	1
DOC	2.0	1.0	mg/l	5310B	01/19/04	1
Sulfide	0.077	0.050	mg/l	9030B	01/16/04	1
TOC (Total Organic Carbon)	1.7	1.0	mg/l	9060	01/15/04	1
Iron	5.8	0.050	mg/l	6010B	01/16/04	1
Iron, Dissolved	0.70	0.050	mg/l	6010B	01/17/04	1
Manganese, Dissolved	2.1	0.010	mg/l	6010B	01/17/04	1
Volatile Organics						
Acetone	BDL	0.050	mg/l	8260B	01/15/04	1
Acrolein	BDL	0.050	mg/l	8260B	01/15/04	1
Acrylonitrile	BDL	0.050	mg/l	8260B	01/15/04	1
Benzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromodichloromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromoform	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
n-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
sec-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
tert-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Carbon tetrachloride	BDL	0.0010	mg/l	8260B	01/15/04	1
Chlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Chlorodibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Chloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
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REPORT OF ANALYSIS

January 20, 2004

Mr. Dennis Brinkley
MACTEC - St. Louis, MO
3199 Riverport Tech Center Drive
St. Louis, MO 63043

Date Received : January 15, 2004
Description : GW - Boeing

Sample ID : MW3W

Collected By : Jack E Friesner
Collection Date : 01/14/04 16:30

ESC Sample # : L141005-03

Site ID :

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
2-Chloroethyl vinyl ether	BDL	0.050	mg/l	8260B	01/15/04	1
Chloroform	BDL	0.0050	mg/l	8260B	01/15/04	1
Chloromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
2-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
4-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dibromo-3-Chloropropane	BDL	0.0020	mg/l	8260B	01/15/04	1
1,2-Dibromoethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Dibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,4-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Dichlorodifluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloroethene	0.014	0.0010	mg/l	8260B	01/15/04	1
cis-1,2-Dichloroethene	2.6	0.0010	mg/l	8260B	01/15/04	1
trans-1,2-Dichloroethene	0.10	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
cis-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
trans-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
2,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
Di-isopropyl ether	BDL	0.0010	mg/l	8260B	01/15/04	1
Ethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Hexachlorobutadiene	BDL	0.0010	mg/l	8260B	01/15/04	1
Isopropylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
p-Isopropyltoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
2-Butanone (MEK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methylene Chloride	BDL	0.0050	mg/l	8260B	01/15/04	1
4-Methyl-2-pentanone (MIBK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methyl tert-butyl ether	BDL	0.0010	mg/l	8260B	01/15/04	1
Naphthalene	BDL	0.0050	mg/l	8260B	01/15/04	1
n-Propylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Styrene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,1,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2-Trichloro-1,2,2-trifluoro	BDL	0.0010	mg/l	8260B	01/15/04	1
Tetrachloroethene	BDL	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
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REPORT OF ANALYSIS

Mr. Dennis Brinkley
MACTEC - St. Louis, MO
3199 Riverport Tech Center Drive
St. Louis, MO 63043

January 20, 2004

Date Received : January 15, 2004
Description : GW - Boeing

ESC Sample # : L141005-03

Sample ID : MW3W

Site ID :

Collected By : Jack E Friesner
Collection Date : 01/14/04 16:30

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Toluene	BDL	0.0050	mg/l	8260B	01/15/04	1
1,2,3-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,1-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Trichloroethene	0.034	0.0010	mg/l	8260B	01/15/04	1
Trichlorofluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3,5-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Vinyl chloride	1.0	0.0010	mg/l	8260B	01/15/04	1
Xylenes, Total	BDL	0.0030	mg/l	8260B	01/15/04	1
Surrogate Recovery						
Toluene-d8	100		% Rec.	8260B	01/15/04	1
Dibromofluoromethane	100		% Rec.	8260B	01/15/04	1
4-Bromofluorobenzene	100		% Rec.	8260B	01/15/04	1


Jeff Carr, ESC Representative

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Note:

The reported analytical results relate only to the sample submitted.

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Reported: 01/20/04 09:23 Printed: 01/20/04 15:02

Attachment A
List of Analytes with QC Qualifiers

Sample #	Analyte	Qualifier
L141005-01	DOC	W
	Chloride	J4
	Acrolein	J4
	Bromodichloromethane	J3
	Bromomethane	J3
	2-Chloroethyl vinyl ether	J4J3
	Dibromomethane	J3
	cis-1,2-Dichloroethene	E
	1,2-Dichloropropane	J3
	2-Butanone (MEK)	J3
	4-Methyl-2-pentanone (MIBK)	J3
	Trichloroethene	E
	1,2,3-Trichloropropane	J3
L141005-02	DOC	W
	Chloride	J4
	Nitrite	L Q
	Acrolein	J4J5
	Acrylonitrile	J3
	2-Chloroethyl vinyl ether	J4
	2-Butanone (MEK)	J3
	Methyl tert-butyl ether	J5
	1,1,2,2-Tetrachloroethane	J3
	DOC	W
L141005-03	Chloride	J4
	Acrolein	J4
	Bromodichloromethane	J3
	Bromomethane	J3
	2-Chloroethyl vinyl ether	J4J3
	Dibromomethane	J3
	cis-1,2-Dichloroethene	E
	1,2-Dichloropropane	J3
	2-Butanone (MEK)	J3
	4-Methyl-2-pentanone (MIBK)	J3
	1,2,3-Trichloropropane	J3
	Vinyl chloride	E

Attachment B
Explanation of QC Qualifier Codes

Qualifier	Meaning
E	GTL (EPA) - Greater than upper calibration limit: Actual value is known to be greater than the upper calibration range.
J3	The associated batch QC was outside the established quality control range for precision.
J4	The associated batch QC was outside the established quality control range for accuracy.
J5	The sample matrix interfered with the ability to make any accurate determination; spike value is high
Q	(ESC) Sample held beyond the accepted holding time.
L	(ESC) Sample Pretreatment: The sample reaction impaired the ability to analyze the sample using normal analytical determination. Treatment outside of method protocol was required to determine the analytical result.
W	(ESC)-The laboratory analysis was from a sample collected in an improper container

Qualifier Report Information

ESC utilizes sample and result qualifiers as set forth by the EPA Contract Laboratory Program and as required by most certifying bodies including NELAC. In addition to the EPA qualifiers adopted by ESC, we have implemented ESC qualifiers to provide more information pertaining to our analytical results. Each qualifier is designated in the qualifier explanation as either EPA or ESC. Data qualifiers are intended to provide the ESC client with more detailed information concerning the potential bias of reported data. Because of the wide range of constituents and variety of matrices incorporated by most EPA methods, it is common for some compounds to fall outside of established ranges. These exceptions are evaluated and all reported data is valid and useable unless qualified as 'R' (Rejected).

Definitions

- Accuracy** - The relationship of the observed value of a known sample to the true value of a known sample. Represented by percent recovery and relevant to samples such as: control samples, matrix spike recoveries, surrogate recoveries, etc.
- Precision** - The agreement between a set of samples or between duplicate samples. Relates to how close together the results are and is represented by Relative Percent Difference.
- Surrogate** - Organic compounds that are similar in chemical composition, extraction, and chromatography to analytes of interest. The surrogates are used to determine the probable response of the group of analytes that are chemically related to the surrogate compound. Surrogates are added to the sample and carried through all stages of preparation and analyses.

Control Limits

2-Fluorophenol	31-119	Nitrobenzene-d5	43-118	Dibromfluoromethane	79-126	83-119
Phenol-d5	12-134	2-Fluorobiphenyl	45-128	Toluene-d8	81-114	82-116
2,4,6-Tribromophenol	51-141	Terphenyl-d14	43-137	4-Bromofluorobenzene	65-129	72-126

- TIC** - Tentatively Identified Compound: Compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates.

Summary of Remarks For Samples Printed
01/20/04 at 15:02:58

TSR Signing Reports: 206
R5 - Desired TAT

Needs EDD in PPB format.

Sample: L141005-01 Account: HARDMO Received: 01/15/04 09:30 Due Date: 01/22/04 00:00 RPT Date: 01/20/04 09:23
Needs EDD PPM FORMAT
Sample: L141005-02 Account: HARDMO Received: 01/15/04 09:30 Due Date: 01/22/04 00:00 RPT Date: 01/20/04 09:23
Needs EDD PPM FORMAT
Sample: L141005-03 Account: HARDMO Received: 01/15/04 09:30 Due Date: 01/22/04 00:00 RPT Date: 01/20/04 09:23
Needs EDD PPM FORMAT



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MACTEC - St. Louis, MO
Mr. Dennis Brinkley
3199 Riverport Tech Center Drive
St. Louis, MO 63043

Quality Assurance Report
Level II

January 20, 2004

L141005

Analyte	Result	Laboratory Blank		Date Analyzed	Batch
		Units			
Nitrate	< .1	mg/l		01/15/04 18:08	WG140525
Nitrite	< .1	mg/l		01/15/04 18:08	WG140525
Sulfate	< 5	mg/l		01/15/04 18:08	WG140525
TOC (Total Organic Carbon)	< 1	mg/l		01/15/04 13:17	WG140588
Iron	< .05	mg/l		01/16/04 02:18	WG140610
Free Carbon Dioxide	< 10	mg/l		01/15/04 17:30	WG140619
1,1,1,2-Tetrachloroethane	< .001	mg/l		01/15/04 14:36	WG140662
1,1,1-Trichloroethane	< .001	mg/l		01/15/04 14:36	WG140662
1,1,2,2-Tetrachloroethane	< .001	mg/l		01/15/04 14:36	WG140662
1,1,2-Trichloro-1,2,2-trifluoroethane	< .001	mg/l		01/15/04 14:36	WG140662
1,1,2-Trichloroethane	< .001	mg/l		01/15/04 14:36	WG140662
1,1-Dichloroethane	< .001	mg/l		01/15/04 14:36	WG140662
1,1-Dichloroethene	< .001	mg/l		01/15/04 14:36	WG140662
1,1-Dichloropropene	< .001	mg/l		01/15/04 14:36	WG140662
1,2,3-Trichlorobenzene	< .001	mg/l		01/15/04 14:36	WG140662
1,2,3-Trichloropropane	< .001	mg/l		01/15/04 14:36	WG140662
1,2,3-Trimethylbenzene	< .001	mg/l		01/15/04 14:36	WG140662
1,2,4-Trichlorobenzene	< .001	mg/l		01/15/04 14:36	WG140662
1,2,4-Trimethylbenzene	< .001	mg/l		01/15/04 14:36	WG140662
1,2-Dibromo-3-Chloropropane	< .002	mg/l		01/15/04 14:36	WG140662
1,2-Dibromoethane	< .001	mg/l		01/15/04 14:36	WG140662
1,2-Dichlorobenzene	< .001	mg/l		01/15/04 14:36	WG140662
1,2-Dichloroethane	< .001	mg/l		01/15/04 14:36	WG140662
1,2-Dichloropropane	< .001	mg/l		01/15/04 14:36	WG140662
1,3,5-Trimethylbenzene	< .001	mg/l		01/15/04 14:36	WG140662
1,3-Dichlorobenzene	< .001	mg/l		01/15/04 14:36	WG140662
1,3-Dichloropropane	< .001	mg/l		01/15/04 14:36	WG140662
1,4-Dichlorobenzene	< .001	mg/l		01/15/04 14:36	WG140662
2,2-Dichloropropane	< .001	mg/l		01/15/04 14:36	WG140662
2-Butanone (MEK)	< .05	mg/l		01/15/04 14:36	WG140662
2-Chloroethyl vinyl ether	< .05	mg/l		01/15/04 14:36	WG140662
2-Chlorotoluene	< .001	mg/l		01/15/04 14:36	WG140662
4-Chlorotoluene	< .001	mg/l		01/15/04 14:36	WG140662
4-Methyl-2-pentanone (MIBK)	< .05	mg/l		01/15/04 14:36	WG140662
Acetone	< .05	mg/l		01/15/04 14:36	WG140662
Acrolein	< .05	mg/l		01/15/04 14:36	WG140662
Acrylonitrile	< .05	mg/l		01/15/04 14:36	WG140662
Benzene	< .001	mg/l		01/15/04 14:36	WG140662
Bromobenzene	< .001	mg/l		01/15/04 14:36	WG140662
Bromodichloromethane	< .001	mg/l		01/15/04 14:36	WG140662
Bromoform	< .001	mg/l		01/15/04 14:36	WG140662
Bromomethane	< .001	mg/l		01/15/04 14:36	WG140662
Carbon tetrachloride	< .001	mg/l		01/15/04 14:36	WG140662
Chlorobenzene	< .001	mg/l		01/15/04 14:36	WG140662
Chlorodibromomethane	< .001	mg/l		01/15/04 14:36	WG140662
Chloroethane	< .001	mg/l		01/15/04 14:36	WG140662
Chloroform	< .005	mg/l		01/15/04 14:36	WG140662
Chloromethane	< .001	mg/l		01/15/04 14:36	WG140662
cis-1,2-Dichloroethene	< .001	mg/l		01/15/04 14:36	WG140662
cis-1,3-Dichloropropene	< .001	mg/l		01/15/04 14:36	WG140662
Di-isopropyl ether	< .001	mg/l		01/15/04 14:36	WG140662
Dibromomethane	< .001	mg/l		01/15/04 14:36	WG140662
Dichlorodifluoromethane	< .001	mg/l		01/15/04 14:36	WG140662
Ethylbenzene	< .001	mg/l		01/15/04 14:36	WG140662
Hexachlorobutadiene	< .001	mg/l		01/15/04 14:36	WG140662
Isopropylbenzene	< .001	mg/l		01/15/04 14:36	WG140662



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Mr. Dennis Brinkley
3199 Riverport Tech Center Drive
St. Louis, MO 63043

Quality Assurance Report Level II

L141005

January 20, 2004

Methyl tert-butyl ether < .001 mg/l 01/15/04 14:36 WG140662

Analyte	Result	Laboratory Blank Units	Date Analyzed	Batch
Methylene Chloride	< .005	mg/l	01/15/04 14:36	WG140662
n-Butylbenzene	< .001	mg/l	01/15/04 14:36	WG140662
n-Propylbenzene	< .001	mg/l	01/15/04 14:36	WG140662
Naphthalene	< .005	mg/l	01/15/04 14:36	WG140662
p-Isopropyltoluene	< .001	mg/l	01/15/04 14:36	WG140662
sec-Butylbenzene	< .001	mg/l	01/15/04 14:36	WG140662
Styrene	< .001	mg/l	01/15/04 14:36	WG140662
tert-Butylbenzene	< .001	mg/l	01/15/04 14:36	WG140662
Tetrachloroethene	< .001	mg/l	01/15/04 14:36	WG140662
Toluene	< .005	mg/l	01/15/04 14:36	WG140662
trans-1,2-Dichloroethene	< .001	mg/l	01/15/04 14:36	WG140662
trans-1,3-Dichloropropene	< .001	mg/l	01/15/04 14:36	WG140662
Trichloroethene	< .001	mg/l	01/15/04 14:36	WG140662
Trichlorofluoromethane	< .001	mg/l	01/15/04 14:36	WG140662
Vinyl chloride	< .001	mg/l	01/15/04 14:36	WG140662
Xylenes, Total	< .003	mg/l	01/15/04 14:36	WG140662
Iron, Dissolved	< .05	mg/l	01/17/04 01:16	WG140681
Manganese, Dissolved	< .01	mg/l	01/17/04 01:16	WG140681
Chloride	< 1	mg/l	01/16/04 18:17	WG140706
Nitrite	< .1	mg/l	01/16/04 18:17	WG140706
Sulfide	< .05	mg/l	01/16/04 15:00	WG140829
DOC	< 1	mg/l	01/19/04 11:44	WG140996

Analyte	Units	Duplicate Result	Duplicate	RPD	Limit	Ref Samp	Batch
Nitrate	mg/l	0.00	0.00	0.00	20	L141005-03	WG140525
Nitrite	mg/l	0.00	0.00	0.00	20	L141005-03	WG140525
Sulfate	mg/l	40.8	41.0	0.585	20	L141005-03	WG140525
TOC (Total Organic Carbon)	mg/l	0.00	0.00	0.00	20	L140971-02	WG140588
Free Carbon Dioxide	mg/l	119.	120.	0.837	20	L141005-02	WG140619
Sulfide	mg/l	0.0848	0.0770	9.64	20	L141005-03	WG140829
DOC	mg/l	1.23	1.40	13.0	20	L141005-02	WG140996

Analyte	Units	Laboratory Control Known Val	Sample Result	% Rec	Limit	Batch
Nitrate	mg/l	4	3.68	92.0	90-110	WG140525
Nitrite	mg/l	4	3.55	88.8	85-115	WG140525
Sulfate	mg/l	20	17.7	88.6	90-110	WG140525
TOC (Total Organic Carbon)	mg/l	4	4.40	110.	85-115	WG140588
Iron	mg/l	1.13	1.04	92.0	85-115	WG140610
1,1,1,2-Tetrachloroethane	mg/l	.02	0.0211	105.	84-128	WG140662
1,1,1-Trichloroethane	mg/l	.02	0.0181	90.5	71-122	WG140662
1,1,2,2-Tetrachloroethane	mg/l	.02	0.0210	105.	78-120	WG140662
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/l	.02	0.0157	78.5	37-127	WG140662
1,1,2-Trichloroethane	mg/l	.02	0.0190	95.2	82-117	WG140662
1,1-Dichloroethane	mg/l	.02	0.0188	94.2	59-135	WG140662



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L141005

1,1-Dichloroethene	mg/l	.02	0.0182	90.8	60-166	WG140662
Analyte	Units	Laboratory Control Known Val	Sample Result	% Rec	Limit	Batch
1,1-Dichloropropene	mg/l	.02	0.0172	85.8	67-132	WG140662
1,2,3-Trichlorobenzene	mg/l	.02	0.0210	105.	81-122	WG140662
1,2,3-Trichloropropane	mg/l	.02	0.0205	102.	78-122	WG140662
1,2,3-Trimethylbenzene	mg/l	.02	0.0169	84.3	64-100	WG140662
1,2,4-Trichlorobenzene	mg/l	.02	0.0214	107.	78-132	WG140662
1,2,4-Trimethylbenzene	mg/l	.02	0.0204	102.	82-117	WG140662
1,2-Dibromo-3-Chloropropane	mg/l	.02	0.0201	101.	58-140	WG140662
1,2-Dibromoethane	mg/l	.02	0.0203	101.	79-121	WG140662
1,2-Dichlorobenzene	mg/l	.02	0.0195	97.3	83-113	WG140662
1,2-Dichloroethane	mg/l	.02	0.0197	98.5	81-122	WG140662
1,2-Dichloropropane	mg/l	.02	0.0247	124.	74-125	WG140662
1,3,5-Trimethylbenzene	mg/l	.02	0.0197	98.4	80-118	WG140662
1,3-Dichlorobenzene	mg/l	.02	0.0209	104.	80-124	WG140662
1,3-Dichloropropane	mg/l	.02	0.0202	101.	86-120	WG140662
1,4-Dichlorobenzene	mg/l	.02	0.0194	97.2	84-115	WG140662
2,2-Dichloropropane	mg/l	.02	0.0192	95.9	71-131	WG140662
2-Butanone (MEK)	mg/l	.1	0.106	106.	25-137	WG140662
2-Chloroethyl vinyl ether	mg/l	.1	0.00188	1.88	15-161	WG140662
2-Chlorotoluene	mg/l	.02	0.0192	96.1	79-112	WG140662
4-Chlorotoluene	mg/l	.02	0.0198	99.0	82-116	WG140662
4-Methyl-2-pentanone (MIBK)	mg/l	.1	0.108	108.	57-145	WG140662
Acetone	mg/l	.1	0.0916	91.6	14-115	WG140662
Acrolein	mg/l	.1	0.201	201.	16-83	WG140662
Acrylonitrile	mg/l	.1	0.0916	91.6	32-142	WG140662
Benzene	mg/l	.02	0.0187	93.3	66-127	WG140662
Bromobenzene	mg/l	.02	0.0207	104.	79-127	WG140662
Bromodichloromethane	mg/l	.02	0.0218	109.	76-117	WG140662
Bromoform	mg/l	.02	0.0220	110.	72-125	WG140662
Bromomethane	mg/l	.02	0.0102	51.1	25-170	WG140662
Carbon tetrachloride	mg/l	.02	0.0180	89.9	65-127	WG140662
Chlorobenzene	mg/l	.02	0.0195	97.6	79-117	WG140662
Chlorodibromomethane	mg/l	.02	0.0197	98.3	76-115	WG140662
Chloroethane	mg/l	.02	0.0133	66.7	37-130	WG140662
Chloroform	mg/l	.02	0.0191	95.6	70-119	WG140662
Chloromethane	mg/l	.02	0.0104	52.0	39-109	WG140662
cis-1,2-Dichloroethene	mg/l	.02	0.0185	92.5	72-128	WG140662
cis-1,3-Dichloropropene	mg/l	.02	0.0210	105.	86-137	WG140662
Di-isopropyl ether	mg/l	.02	0.0207	103.	54-147	WG140662
Dibromomethane	mg/l	.02	0.0217	109.	81-117	WG140662
Dichlorodifluoromethane	mg/l	.02	0.00559	28.0	14-133	WG140662
Ethylbenzene	mg/l	.02	0.0187	93.6	75-117	WG140662
Hexachlorobutadiene	mg/l	.02	0.0176	87.8	68-122	WG140662
Isopropylbenzene	mg/l	.02	0.0173	86.5	67-113	WG140662
Methyl tert-butyl ether	mg/l	.02	0.0218	109.	65-128	WG140662
Methylene Chloride	mg/l	.02	0.0191	95.4	60-127	WG140662
n-Butylbenzene	mg/l	.02	0.0188	94.1	74-125	WG140662
n-Propylbenzene	mg/l	.02	0.0191	95.5	74-120	WG140662
Naphthalene	mg/l	.02	0.0183	91.6	51-127	WG140662
p-Isopropyltoluene	mg/l	.02	0.0196	97.9	74-122	WG140662
sec-Butylbenzene	mg/l	.02	0.0182	90.9	66-118	WG140662
Styrene	mg/l	.02	0.0198	99.2	78-114	WG140662
tert-Butylbenzene	mg/l	.02	0.0201	101.	69-121	WG140662
Tetrachloroethene	mg/l	.02	0.0187	93.3	71-132	WG140662
Toluene	mg/l	.02	0.0194	97.1	68-122	WG140662
trans-1,2-Dichloroethene	mg/l	.02	0.0176	88.0	65-141	WG140662
trans-1,3-Dichloropropene	mg/l	.02	0.0198	98.8	82-132	WG140662
Trichloroethene	mg/l	.02	0.0181	90.7	81-129	WG140662
Trichlorofluoromethane	mg/l	.02	0.0125	62.7	46-94	WG140662
Vinyl chloride	mg/l	.02	0.0115	57.6	40-95	WG140662



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L141005

January 20, 2004

Xylenes, Total	mg/l	.06	0.0574	95.7	78-114	WG140662
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Analyte	Units	Laboratory Control Known Val	Sample Result	% Rec	Limit	Batch
Iron, Dissolved	mg/l	1.13	1.19	105.	85-115	WG140681
Manganese, Dissolved	mg/l	1.13	1.20	106.	85-115	WG140681
Chloride	mg/l	20	17.0	85.1	90-110	WG140706
Nitrite	mg/l	4	3.56	89.1	85-115	WG140706
Sulfide	mg/l	.5	0.530	106.	85-115	WG140829
DOC	mg/l	4	4.60	115.	85-115	WG140996

Analyte	Units	Laboratory Control LCS Res	Sample Ref Res	Duplicate RPD	Limit	Ref Samp	Batch
Nitrate	mg/l	3.62	3.68	1.59	20	R184382-5	WG140525
Nitrite	mg/l	3.54	3.55	0.421	20	R184382-5	WG140525
Sulfate	mg/l	17.6	17.7	0.872	20	R184382-5	WG140525
TOC (Total Organic Carbon)	mg/l	4.30	4.40	2.30	20	WG140588-2	WG140588
Iron	mg/l	1.06	1.04	1.90	20	R184336-3	WG140610
1,1,1,2-Tetrachloroethane	mg/l	0.0208	0.0211	1.24	16	R184421-5	WG140662
1,1,1-Trichloroethane	mg/l	0.0177	0.0181	2.52	28	R184421-5	WG140662
1,1,2,2-Tetrachloroethane	mg/l	0.0198	0.0210	5.83	10	R184421-5	WG140662
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/l	0.0151	0.0157	3.70	40	R184421-5	WG140662
1,1,2-Trichloroethane	mg/l	0.0184	0.0190	3.31	16	R184421-5	WG140662
1,1-Dichloroethane	mg/l	0.0189	0.0188	0.424	17	R184421-5	WG140662
1,1-Dichloroethene	mg/l	0.0175	0.0182	3.64	36	R184421-5	WG140662
1,1-Dichloropropene	mg/l	0.0168	0.0172	1.88	33	R184421-5	WG140662
1,2,3-Trichlorobenzene	mg/l	0.0199	0.0210	5.39	17	R184421-5	WG140662
1,2,3-Trichloropropane	mg/l	0.0179	0.0205	13.5	13	R184421-5	WG140662
1,2,3-Trimethylbenzene	mg/l	0.0168	0.0169	0.535	20	R184421-5	WG140662
1,2,4-Trichlorobenzene	mg/l	0.0210	0.0214	1.65	25	R184421-5	WG140662
1,2,4-Trimethylbenzene	mg/l	0.0204	0.0204	0.245	29	R184421-5	WG140662
1,2-Dibromo-3-Chloropropane	mg/l	0.0172	0.0201	15.8	21	R184421-5	WG140662
1,2-Dibromoethane	mg/l	0.0190	0.0203	6.31	19	R184421-5	WG140662
1,2-Dichlorobenzene	mg/l	0.0188	0.0195	3.29	16	R184421-5	WG140662
1,2-Dichloroethane	mg/l	0.0185	0.0197	6.45	13	R184421-5	WG140662
1,2-Dichloropropane	mg/l	0.0196	0.0247	23.0	14	R184421-5	WG140662
1,3,5-Trimethylbenzene	mg/l	0.0198	0.0197	0.608	28	R184421-5	WG140662
1,3-Dichlorobenzene	mg/l	0.0209	0.0209	0.0480	25	R184421-5	WG140662
1,3-Dichloropropane	mg/l	0.0193	0.0202	4.46	15	R184421-5	WG140662
1,4-Dichlorobenzene	mg/l	0.0193	0.0194	0.930	18	R184421-5	WG140662
2,2-Dichloropropane	mg/l	0.0184	0.0192	3.93	31	R184421-5	WG140662
2-Butanone (MEK)	mg/l	0.0946	0.106	11.1	10	R184421-5	WG140662
2-Chloroethyl vinyl ether	mg/l	0.0014	0.0018	27.9	25	R184421-5	WG140662
2-Chlorotoluene	mg/l	0.0192	0.0192	0.156	24	R184421-5	WG140662
4-Chlorotoluene	mg/l	0.0194	0.0198	2.09	22	R184421-5	WG140662
4-Methyl-2-pentanone (MIBK)	mg/l	0.0951	0.108	12.5	12	R184421-5	WG140662
Acetone	mg/l	0.0795	0.0916	14.1	20	R184421-5	WG140662
Acrolein	mg/l	0.214	0.201	6.55	34	R184421-5	WG140662
Acrylonitrile	mg/l	0.0852	0.0916	7.20	13	R184421-5	WG140662
Benzene	mg/l	0.0185	0.0187	0.699	20	R184421-5	WG140662
Bromobenzene	mg/l	0.0204	0.0207	1.65	22	R184421-5	WG140662
Bromodichloromethane	mg/l	0.0189	0.0218	14.3	13	R184421-5	WG140662
Bromoform	mg/l	0.0205	0.0220	6.97	18	R184421-5	WG140662
Bromomethane	mg/l	0.0082	0.0102	21.5	20	R184421-5	WG140662
Carbon tetrachloride	mg/l	0.0175	0.0180	2.53	36	R184421-5	WG140662
Chlorobenzene	mg/l	0.0193	0.0195	1.39	21	R184421-5	WG140662



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Chlorodibromomethane	mg/l	0.0186	0.0197	5.54	17	R184421-5	WG140662
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Analyte	Units	Laboratory Control Sample Duplicate				Limit	Ref Samp	Batch
		LCSD	Res	Ref	RPD			
Chloroethane	mg/l	0.0126	0.0133	6.10	25		R184421-5	WG140662
Chloroform	mg/l	0.0194	0.0191	1.35	26		R184421-5	WG140662
Chloromethane	mg/l	0.0097	0.0104	6.97	31		R184421-5	WG140662
cis-1,2-Dichloroethene	mg/l	0.0181	0.0185	2.24	18		R184421-5	WG140662
cis-1,3-Dichloropropene	mg/l	0.0203	0.0210	3.53	17		R184421-5	WG140662
Di-isopropyl ether	mg/l	0.0207	0.0207	0.386	13		R184421-5	WG140662
Dibromomethane	mg/l	0.0182	0.0217	17.5	12		R184421-5	WG140662
Dichlorodifluoromethane	mg/l	0.0053	0.0055	3.83	28		R184421-5	WG140662
Ethylbenzene	mg/l	0.0188	0.0187	0.160	25		R184421-5	WG140662
Hexachlorobutadiene	mg/l	0.0165	0.0176	5.99	36		R184421-5	WG140662
Isopropylbenzene	mg/l	0.0169	0.0173	2.04	29		R184421-5	WG140662
Methyl tert-butyl ether	mg/l	0.0208	0.0218	4.84	16		R184421-5	WG140662
Methylene Chloride	mg/l	0.0187	0.0191	2.07	16		R184421-5	WG140662
n-Butylbenzene	mg/l	0.0187	0.0188	0.587	30		R184421-5	WG140662
n-Propylbenzene	mg/l	0.0190	0.0191	0.473	30		R184421-5	WG140662
Naphthalene	mg/l	0.0166	0.0183	9.67	39		R184421-5	WG140662
p-Isopropyltoluene	mg/l	0.0198	0.0196	0.916	36		R184421-5	WG140662
sec-Butylbenzene	mg/l	0.0184	0.0182	1.09	32		R184421-5	WG140662
Styrene	mg/l	0.0199	0.0198	0.151	21		R184421-5	WG140662
tert-Butylbenzene	mg/l	0.0200	0.0201	0.398	30		R184421-5	WG140662
Tetrachloroethene	mg/l	0.0188	0.0187	0.854	32		R184421-5	WG140662
Toluene	mg/l	0.0191	0.0194	1.87	17		R184421-5	WG140662
trans-1,2-Dichloroethene	mg/l	0.0176	0.0176	0.00	27		R184421-5	WG140662
trans-1,3-Dichloropropene	mg/l	0.0187	0.0198	5.62	16		R184421-5	WG140662
Trichloroethene	mg/l	0.0178	0.0181	1.72	25		R184421-5	WG140662
Trichlorofluoromethane	mg/l	0.0120	0.0125	4.65	41		R184421-5	WG140662
Vinyl chloride	mg/l	0.0109	0.0115	5.81	36		R184421-5	WG140662
Xylenes, Total	mg/l	0.0586	0.0574	2.05	21		R184421-5	WG140662
Iron, Dissolved	mg/l	1.21	1.19	1.67	20		R184440-3	WG140681
Manganese, Dissolved	mg/l	1.20	1.20	0.00	20		R184440-3	WG140681
Chloride	mg/l	16.7	17.0	1.66	20		R184491-2	WG140706
Nitrite	mg/l	3.51	3.56	1.51	20		R184491-2	WG140706
Sulfide	mg/l	0.500	0.530	5.83	20		WG140829-2	WG140829
DOC	mg/l	3.90	4.60	16.5	20		WG140996-2	WG140996

Analyte	Units	Matrix Spike				% Rec	Limit	Ref Samp	Batch
		MS	Res	Ref	TV				
Nitrate	mg/l	4.74	0.0228	5		94.4	80-120	L140643-21	WG140525
Nitrite	mg/l	4.72	0.00	5		94.5	80-120	L140643-21	WG140525
Sulfate	mg/l	48.2	0.00	50		96.4	80-120	L140643-21	WG140525
TOC (Total Organic Carbon)	mg/l	20.0	0.00	20		100.	80-120	L140971-01	WG140588
Iron	mg/l	1.05	0.00	1.13		93.0	75-125	L141005-01	WG140610
1,1,1,2-Tetrachloroethane	mg/l	0.0210	0.00	0.02		105.	67-139	L141005-02	WG140662
1,1,1-Trichloroethane	mg/l	0.0183	0.00	0.02		91.4	46-143	L141005-02	WG140662
1,1,2,2-Tetrachloroethane	mg/l	0.0211	0.00	0.02		105.	70-116	L141005-02	WG140662
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/l	0.0190	0.00	0.02		94.8	30-134	L141005-02	WG140662
1,1,2-Trichloroethane	mg/l	0.0174	0.00	0.02		87.0	70-122	L141005-02	WG140662
1,1-Dichloroethane	mg/l	0.0203	0.00	0.02		102.	47-138	L141005-02	WG140662
1,1-Dichloroethene	mg/l	0.0218	0.00	0.02		109.	56-162	L141005-02	WG140662
1,1-Dichloropropene	mg/l	0.0187	0.00	0.02		93.7	49-140	L141005-02	WG140662
1,2,3-Trichlorobenzene	mg/l	0.0155	0.00	0.02		77.4	63-124	L141005-02	WG140662



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Mr. Dennis Brinkley
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St. Louis, MO 63043

Quality Assurance Report Level II

January 20, 2004

L141005

1,2,3-Trichloropropane mg/l 0.0192 0.00 0.02 95.9 66-124 L141005-02 WG140662

Analyte	Units	Matrix MS Res	Spike Ref Res	TV	% Rec	Limit	Ref Samp	Batch
1,2,3-Trimethylbenzene	mg/l	0.0163	0.00	0.02	81.7	51-109	L141005-02	WG140662
1,2,4-Trichlorobenzene	mg/l	0.0151	0.00	0.02	75.6	52-130	L141005-02	WG140662
1,2,4-Trimethylbenzene	mg/l	0.0220	0.00	0.02	110.	62-126	L141005-02	WG140662
1,2-Dibromo-3-Chloropropane	mg/l	0.0199	0.00	0.02	99.5	48-122	L141005-02	WG140662
1,2-Dibromoethane	mg/l	0.0206	0.00	0.02	103.	74-121	L141005-02	WG140662
1,2-Dichlorobenzene	mg/l	0.0164	0.00	0.02	82.0	65-119	L141005-02	WG140662
1,2-Dichloroethane	mg/l	0.0188	0.00	0.02	93.8	48-148	L141005-02	WG140662
1,2-Dichloropropane	mg/l	0.0193	0.00	0.02	96.7	66-122	L141005-02	WG140662
1,3,5-Trimethylbenzene	mg/l	0.0194	0.00	0.02	96.8	60-127	L141005-02	WG140662
1,3-Dichlorobenzene	mg/l	0.0186	0.00	0.02	92.8	62-122	L141005-02	WG140662
1,3-Dichloropropane	mg/l	0.0206	0.00	0.02	103.	77-121	L141005-02	WG140662
1,4-Dichlorobenzene	mg/l	0.0160	0.00	0.02	79.8	60-123	L141005-02	WG140662
2,2-Dichloropropane	mg/l	0.0193	0.00	0.02	96.4	40-148	L141005-02	WG140662
2-Butanone (MEK)	mg/l	0.107	0.00	0.1	107.	26-114	L141005-02	WG140662
2-Chloroethyl vinyl ether	mg/l	0.00	0.00	0.1	0.0	0-100	L141005-02	WG140662
2-Chlorotoluene	mg/l	0.0187	0.00	0.02	93.5	62-120	L141005-02	WG140662
4-Chlorotoluene	mg/l	0.0185	0.00	0.02	92.3	63-123	L141005-02	WG140662
4-Methyl-2-pentanone (MIBK)	mg/l	0.0871	0.00	0.1	87.1	56-133	L141005-02	WG140662
Acetone	mg/l	0.0960	0.00	0.1	96.0	13-145	L141005-02	WG140662
Acrolein	mg/l	0.221	0.00	0.1	221.	14-90	L141005-02	WG140662
Acrylonitrile	mg/l	0.107	0.00	0.1	107.	33-128	L141005-02	WG140662
Benzene	mg/l	0.0215	0.00	0.02	107.	55-130	L141005-02	WG140662
Bromobenzene	mg/l	0.0197	0.00	0.02	98.4	67-134	L141005-02	WG140662
Bromodichloromethane	mg/l	0.0183	0.00	0.02	91.5	57-126	L141005-02	WG140662
Bromoform	mg/l	0.0214	0.00	0.02	107.	52-130	L141005-02	WG140662
Bromomethane	mg/l	0.0119	0.00	0.02	59.5	17-150	L141005-02	WG140662
Carbon tetrachloride	mg/l	0.0187	0.00	0.02	93.7	42-141	L141005-02	WG140662
Chlorobenzene	mg/l	0.0195	0.00	0.02	97.7	66-125	L141005-02	WG140662
Chlorodibromomethane	mg/l	0.0193	0.00	0.02	96.4	58-123	L141005-02	WG140662
Chloroethane	mg/l	0.0170	0.00	0.02	85.0	29-131	L141005-02	WG140662
Chloroform	mg/l	0.0191	0.00	0.02	95.5	46-136	L141005-02	WG140662
Chloromethane	mg/l	0.0173	0.00	0.02	86.4	26-120	L141005-02	WG140662
cis-1,2-Dichloroethene	mg/l	0.0230	0.0062	0.02	83.9	59-133	L141005-02	WG140662
cis-1,3-Dichloropropene	mg/l	0.0171	0.00	0.02	85.3	77-132	L141005-02	WG140662
Di-isopropyl ether	mg/l	0.0233	0.00	0.02	117.	47-141	L141005-02	WG140662
Dibromomethane	mg/l	0.0176	0.00	0.02	87.9	64-119	L141005-02	WG140662
Dichlorodifluoromethane	mg/l	0.0133	0.00	0.02	66.4	13-113	L141005-02	WG140662
Ethylbenzene	mg/l	0.0198	0.00	0.02	98.9	61-123	L141005-02	WG140662
Hexachlorobutadiene	mg/l	0.0130	0.00	0.02	65.1	39-138	L141005-02	WG140662
Isopropylbenzene	mg/l	0.0172	0.00	0.02	85.8	56-120	L141005-02	WG140662
Methyl tert-butyl ether	mg/l	0.114	0.00	0.02	571.	43-140	L141005-02	WG140662
Methylene Chloride	mg/l	0.0205	0.00	0.02	103.	55-123	L141005-02	WG140662
n-Butylbenzene	mg/l	0.0153	0.00	0.02	76.4	43-139	L141005-02	WG140662
n-Propylbenzene	mg/l	0.0187	0.00	0.02	93.7	57-127	L141005-02	WG140662
Naphthalene	mg/l	0.0205	0.00	0.02	102.	39-122	L141005-02	WG140662
p-Isopropyltoluene	mg/l	0.0181	0.00	0.02	90.6	58-127	L141005-02	WG140662
sec-Butylbenzene	mg/l	0.0180	0.00	0.02	89.8	55-124	L141005-02	WG140662
Styrene	mg/l	0.0197	0.00	0.02	98.6	61-119	L141005-02	WG140662
tert-Butylbenzene	mg/l	0.0193	0.00	0.02	96.5	58-129	L141005-02	WG140662
Tetrachloroethene	mg/l	0.0194	0.00	0.02	96.9	49-144	L141005-02	WG140662
Toluene	mg/l	0.0166	0.00	0.02	83.1	59-123	L141005-02	WG140662
trans-1,2-Dichloroethene	mg/l	0.0198	0.00	0.02	99.1	53-145	L141005-02	WG140662
trans-1,3-Dichloropropene	mg/l	0.0159	0.00	0.02	79.4	69-125	L141005-02	WG140662
Trichloroethene	mg/l	0.0184	0.00	0.02	91.8	61-141	L141005-02	WG140662
Trichlorofluoromethane	mg/l	0.0144	0.00	0.02	72.2	24-113	L141005-02	WG140662
Vinyl chloride	mg/l	0.0175	0.0018	0.02	78.4	26-110	L141005-02	WG140662
Xylenes, Total	mg/l	0.0650	0.00	0.06	108.	64-119	L141005-02	WG140662
Iron, Dissolved	mg/l	11.9	11.0	1.13	82.3	75-125	L141005-02	WG140681



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Quality Assurance Report Level II

L141005

January 20, 2004

Manganese, Dissolved mg/l 7.70 6.70 1.13 88.6 75-125 L141005-02 WG140681

Analyte	Units	Matrix Res	Spike Res	TV	% Rec	Limit	Ref Samp	Batch
Sulfide	mg/l	0.960	0.00	1	96.0	80-120	L141005-01	WG140829
DOC	mg/l	20.0	2.60	20	87.0	80-120	L141005-01	WG140996

Analyte	Units	Matrix Res	Spike Res	Duplicate Res	RPD	Limit	% Rec	Ref Samp	Batch
Nitrate	mg/l	4.76	4.74	0.271	20	94.7		L140643-21	WG140525
Nitrite	mg/l	4.75	4.72	0.544	20	95.0		L140643-21	WG140525
Sulfate	mg/l	48.3	48.2	0.151	20	96.6		L140643-21	WG140525
TOC (Total Organic Carbon)	mg/l	20.0	20.0	0.00	20	100.		L140971-01	WG140588
Iron	mg/l	1.09	1.05	3.37	20	96.2		L141005-01	WG140610
1,1,1,2-Tetrachloroethane	mg/l	0.0189	0.0210	10.3	16	94.5		L141005-02	WG140662
1,1,1-Trichloroethane	mg/l	0.0184	0.0183	0.546	28	91.9		L141005-02	WG140662
1,1,2,2-Tetrachloroethane	mg/l	0.0180	0.0211	15.7	10	90.1		L141005-02	WG140662
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/l	0.0180	0.0190	5.19	40	90.0		L141005-02	WG140662
1,1,2-Trichloroethane	mg/l	0.0170	0.0174	2.21	16	85.1		L141005-02	WG140662
1,1-Dichloroethane	mg/l	0.0193	0.0203	5.30	17	96.4		L141005-02	WG140662
1,1-Dichloroethene	mg/l	0.0202	0.0218	7.52	36	101.		L141005-02	WG140662
1,1-Dichloropropene	mg/l	0.0178	0.0187	4.87	33	89.2		L141005-02	WG140662
1,2,3-Trichlorobenzene	mg/l	0.0168	0.0155	8.00	17	83.8		L141005-02	WG140662
1,2,3-Trichloropropane	mg/l	0.0170	0.0192	12.0	13	85.1		L141005-02	WG140662
1,2,3-Trimethylbenzene	mg/l	0.0163	0.0163	0.245	20	81.5		L141005-02	WG140662
1,2,4-Trichlorobenzene	mg/l	0.0158	0.0151	4.15	25	78.8		L141005-02	WG140662
1,2,4-Trimethylbenzene	mg/l	0.0200	0.0220	9.58	29	99.9		L141005-02	WG140662
1,2-Dibromo-3-Chloropropane	mg/l	0.0171	0.0199	14.9	21	85.7		L141005-02	WG140662
1,2-Dibromoethane	mg/l	0.0179	0.0206	14.3	19	89.3		L141005-02	WG140662
1,2-Dichlorobenzene	mg/l	0.0164	0.0164	0.122	16	82.1		L141005-02	WG140662
1,2-Dichloroethane	mg/l	0.0183	0.0188	2.70	13	91.3		L141005-02	WG140662
1,2-Dichloropropane	mg/l	0.0191	0.0193	1.25	14	95.5		L141005-02	WG140662
1,3,5-Trimethylbenzene	mg/l	0.0180	0.0194	7.23	28	90.1		L141005-02	WG140662
1,3-Dichlorobenzene	mg/l	0.0173	0.0186	7.20	25	86.3		L141005-02	WG140662
1,3-Dichloropropane	mg/l	0.0179	0.0206	14.4	15	89.3		L141005-02	WG140662
1,4-Dichlorobenzene	mg/l	0.0164	0.0160	2.41	18	81.8		L141005-02	WG140662
2,2-Dichloropropane	mg/l	0.0188	0.0193	2.31	31	94.2		L141005-02	WG140662
2-Butanone (MEK)	mg/l	0.0934	0.107	13.2	10	93.4		L141005-02	WG140662
2-Chloroethyl vinyl ether	mg/l	0.00	0.00	0.00	25	0.00		L141005-02	WG140662
2-Chlorotoluene	mg/l	0.0170	0.0187	9.41	24	85.1		L141005-02	WG140662
4-Chlorotoluene	mg/l	0.0167	0.0185	9.83	22	83.7		L141005-02	WG140662
4-Methyl-2-pentanone (MIBK)	mg/l	0.0942	0.0871	7.79	12	94.2		L141005-02	WG140662
Acetone	mg/l	0.0826	0.0960	15.0	23	82.6		L141005-02	WG140662
Acrolein	mg/l	0.175	0.221	23.6	34	175.		L141005-02	WG140662
Acrylonitrile	mg/l	0.0930	0.107	13.8	13	93.0		L141005-02	WG140662
Benzene	mg/l	0.0203	0.0215	5.41	20	102.		L141005-02	WG140662
Bromobenzene	mg/l	0.0183	0.0197	7.05	22	91.7		L141005-02	WG140662
Bromodichloromethane	mg/l	0.0181	0.0183	1.04	13	90.6		L141005-02	WG140662
Bromoform	mg/l	0.0191	0.0214	11.6	18	95.5		L141005-02	WG140662
Bromomethane	mg/l	0.0101	0.0119	15.9	20	50.7		L141005-02	WG140662
Carbon tetrachloride	mg/l	0.0185	0.0187	1.40	36	92.4		L141005-02	WG140662
Chlorobenzene	mg/l	0.0176	0.0195	10.5	21	88.0		L141005-02	WG140662
Chlorodibromomethane	mg/l	0.0169	0.0193	13.0	17	84.6		L141005-02	WG140662
Chloroethane	mg/l	0.0152	0.0170	10.9	25	76.2		L141005-02	WG140662
Chloroform	mg/l	0.0185	0.0191	3.36	26	92.3		L141005-02	WG140662
Chloromethane	mg/l	0.0153	0.0173	12.4	31	76.3		L141005-02	WG140662
cis-1,2-Dichloroethene	mg/l	0.0205	0.0230	11.6	18	71.3		L141005-02	WG140662
cis-1,3-Dichloropropene	mg/l	0.0194	0.0171	12.8	17	97.0		L141005-02	WG140662



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Quality Assurance Report
Level II

L141005

January 20, 2004

Di-isopropyl ether mg/l 0.0216 0.0233 7.65 13 108. L141005-02 WG140662

Analyte	Matrix Spike Duplicate				RPD	Limit	%Rec	Ref Samp	Batch
	Units	MSD Res	Ref Res						
Dibromomethane	mg/l	0.0186	0.0176	5.85	12	93.2	L141005-02	WG140662	
Dichlorodifluoromethane	mg/l	0.0129	0.0133	3.29	28	64.3	L141005-02	WG140662	
Ethylbenzene	mg/l	0.0175	0.0198	12.2	25	87.5	L141005-02	WG140662	
Hexachlorobutadiene	mg/l	0.0141	0.0130	7.90	36	70.4	L141005-02	WG140662	
Isopropylbenzene	mg/l	0.0158	0.0172	8.51	29	78.8	L141005-02	WG140662	
Methyl tert-butyl ether	mg/l	0.102	0.114	11.5	16	509.	L141005-02	WG140662	
Methylene Chloride	mg/l	0.0194	0.0205	5.55	16	97.2	L141005-02	WG140662	
n-Butylbenzene	mg/l	0.0155	0.0153	1.24	30	77.4	L141005-02	WG140662	
n-Propylbenzene	mg/l	0.0169	0.0187	10.3	30	84.5	L141005-02	WG140662	
Naphthalene	mg/l	0.0211	0.0205	3.17	39	106.	L141005-02	WG140662	
p-Isopropyltoluene	mg/l	0.0171	0.0181	6.08	36	85.3	L141005-02	WG140662	
sec-Butylbenzene	mg/l	0.0165	0.0180	8.29	32	82.7	L141005-02	WG140662	
Styrene	mg/l	0.0175	0.0197	12.0	21	87.4	L141005-02	WG140662	
tert-Butylbenzene	mg/l	0.0181	0.0193	6.37	30	90.5	L141005-02	WG140662	
Tetrachloroethene	mg/l	0.0177	0.0194	9.01	32	88.6	L141005-02	WG140662	
Toluene	mg/l	0.0190	0.0166	13.4	17	95.0	L141005-02	WG140662	
trans-1,2-Dichloroethene	mg/l	0.0187	0.0198	5.98	27	93.3	L141005-02	WG140662	
trans-1,3-Dichloropropene	mg/l	0.0180	0.0159	12.8	16	90.2	L141005-02	WG140662	
Trichloroethene	mg/l	0.0181	0.0184	1.43	25	90.5	L141005-02	WG140662	
Trichlorofluoromethane	mg/l	0.0140	0.0144	3.02	41	70.1	L141005-02	WG140662	
Vinyl chloride	mg/l	0.0160	0.0175	8.90	36	71.0	L141005-02	WG140662	
Xylenes, Total	mg/l	0.0582	0.0650	11.1	21	96.9	L141005-02	WG140662	
Iron, Dissolved	mg/l	11.9	11.9	0.513	20	76.9	L141005-02	WG140681	
Manganese, Dissolved	mg/l	7.69	7.70	0.143	20	87.6	L141005-02	WG140681	
Sulfide	mg/l	0.990	0.960	3.08	20	99.0	L141005-01	WG140829	
DOC	mg/l	20.0	20.0	0.00	20	87.0	L141005-01	WG140996	

Batch number / Run number / Sample number cross reference

WG140657: R184316: L141005-01 02 03
WG140619: R184323: L141005-01 02 03
WG140610: R184336: L141005-01 02 03
WG140588: R184349: L141005-01 02 03
WG140525: R184382: L141005-01 02 03
WG140662: R184421: L141005-01 02 03
WG140681: R184440: L141005-01 02 03
WG140829: R184444: L141005-01 02 03
WG140706: R184491: L141005-01 02 03
WG140996: R184578: L141005-01 02 03

* See Attachment B of standard report for list of qualifiers.
* Calculations are performed prior to rounding of reported values .



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Quality Assurance Report
Level II

L141005

January 20, 2004

ESC Level 2 Data Package

The data package includes a summary of the analytic results of the quality control samples required by the SW-846 or CWA methods. The quality control samples include a method blank, a laboratory control sample, and the matrix spike/matrix spike duplicate analysis. If a target parameter is outside the method limits, every sample that is effected is flagged with the appropriate qualifier in Appendix B of the analytic report.

Method Blank - an aliquot of reagent water carried through the entire analytic process. The method blank results indicate if any possible contamination exposure during the sample handling, digestion or extraction process, and analysis. Concentrations of target analytes above the reporting limit in the method blank are qualified with the "B" qualifier.

Laboratory Control Sample - is a sample of known concentration that is carried through the digestion/extraction and analysis process. The percent recovery, expressed as a percentage of the theoretical concentration, has statistical control limits indicating that the analytic process is "in control". If a target analyte is outside the control limits for the laboratory control sample or any other control sample, the parameter is flagged with a "J4" qualifier for all effected samples.

Matrix Spike and Matrix Spike Duplicate - is two aliquots of an environmental sample that is spiked with known concentrations of target analytes. The percent recovery of the target analytes also has statistical control limits. If any recoveries that are outside the method control limits, the sample that was selected for matrix spike/matrix spike duplicate analysis is flagged with either a "J5" or a "J6". The relative percent difference (%RPD) between the matrix spike and the matrix spike duplicate recoveries is all calculated. If the RPD is above the method limit, the effected samples are flagged with a "J3" qualifier.

Enhanced Bioremediation Pilot Test Report for McDonnell Douglass, Hazelwood, Missouri

Prepared for:
The Boeing Company
St. Louis, Missouri



Prepared by:
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MACTEC Project Number 32350035046

April 2, 2004



THIS REPORT, TABLES, AND FIGURES WERE PREPARED UNDER THE DIRECTION OF
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Appendices

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Appendix C	Analytical Laboratory Reports and Chain of Custody Forms

List of Abbreviations and Acronyms

bgs	below ground surface
Boeing	Boeing Company
°C	degrees Celsius
°F	degrees Fahrenheit
DCA	dichloroethane
DCE	dichloroethene
DO	dissolved oxygen
DOC	dissolved organic carbon
Facility	Boeing Tract 1 facility
HRC	Hydrogen Release Compound
MACTEC	MACTEC Engineering and Consulting, Inc.
µg/L	micrograms per liter
mg/L	milligrams per liter
mV	millivolt
ORP	redox potential
PCE	perchloroethylene, tetrachloroethene
PVC	polyvinyl chloride
Redox	oxidation-reduction
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
TCE	trichloroethane
TOC	total organic carbon
TPH	total petroleum hydrocarbon
USEPA	U.S. Environmental Protection Agency
VC	vinyl chloride
VOC	volatile organic compounds

1.0 Introduction

This report presents the results of an enhanced bioremediation pilot study conducted by MACTEC Engineering and Consulting, Inc. (MACTEC) on behalf of McDonnell Douglass, a wholly owned subsidiary of The Boeing Company (Boeing). The objective of the pilot study was to measure the ability of a Hydrogen Release Compound® (HRC) to enhance biological activity of reductive dehalogenating microbes to dechlorinate trichloroethene (TCE) and other chlorinated aliphatic hydrocarbons under anaerobic conditions in shallow groundwater at the Boeing Tract 1 Facility (Facility) located in Hazelwood, Missouri (Figure 1-1). The conclusions and results of the pilot study will assist in the development of a Corrective Measure Study for the Boeing Tract 1 Facility.

2.0 Facility Description

The pilot study was conducted at the former Boeing Fabrication Operations Facility (consisting of Buildings 27, 29 and 29A), which is now operated by GKN Aerospace Services. Aircraft components are manufactured at the Fabrications Operations Facility, which has been in operation at the site since 1941. The Fabrication Operations Facility is located on Boeing Tract 1 North, which is bounded on the west by Lindbergh Boulevard, on the south by Banshee Road, and on the east by Coldwater Creek. McDonnell Boulevard bounds the northern portion of the Facility (Figure 2-1).

The Facility is located on generally flat topography in an area known as the Florissant Basin. The Florissant Basin consists of a broad valley cut by the ancestral Coldwater Creek and tributaries. This basin was subsequently in-filled by unconsolidated clay and organic silt deposits approximately 80 feet thick at the Facility. The bedrock unit underlying the unconsolidated deposits consists of Mississippian Age Ste. Genevieve limestone.

At the pilot test area, the surficial material consisted of silty clay. Plasticity in the soil increased with depth from moderate to high between the surface and 20 feet below ground surface (bgs). The upper 15 feet of soil had abundant iron oxidation staining and contained vertical root traces/worm burrows up to 1/8th inch diameter that were infilled with iron oxidation. Below 20 feet bgs the surficial material consisted of increasingly plastic clay.

Shallow groundwater at the pilot test area was encountered between 2 and 6 feet bgs. The shallow groundwater gradient is to the east. The average facility-wide hydraulic gradient was calculated at 0.0107 feet per foot and the average facility-wide linear groundwater velocity was calculated at 7.6 feet per year. Additional site characterization data regarding the Boeing Tract 1 Facility is presented in the Draft Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report (MACTEC, 2003).

3.0 Technology Description

The most important process for the natural degradation of chlorinated compounds is that of reductive dechlorination. Chlorinated ethenes [tetrachloroethene (PCE), TCE, dichloroethene (DCE), vinyl chloride (VC)] are transformed by sequential dechlorination from PCE to TCE to DCE to VC to ethene (U.S. Environmental Protection Agency (USEPA), 1998). The chlorinated compound is utilized as an electron acceptor, with a chlorine atom removed and replaced with a hydrogen atom. Complete reductive dechlorination produces ethane or methane and carbon dioxide (Figure 3-1).

3.1 Environmental Conditions that Support Reductive Dechlorination

Reductive dechlorination occurs under strongly reducing (anaerobic) conditions and requires carbon as a food source for microbes. Environmental conditions that support reductive dechlorination include:

- Microorganisms capable of degrading the contaminants;
- Oxidation-reduction (redox) potential of the groundwater;
- Sufficient electron donors (e.g. a carbon source);
- Limited competing electron acceptors.

3.1.1 Microorganisms

Reductive dechlorination of chlorinated compounds relies on microorganisms that produce enzymes that degrade the contaminants. Generally, if products of complete dechlorination are evident at a site, microorganisms necessary for dechlorination can be assumed to be present (Wisconsin Department of Natural Resources, 2003). At the Facility, degradation products DCE and VC are present in the shallow groundwater in conjunction with PCE and TCE, indicating that dehalogenating microorganisms are present.

3.1.2 Oxidation-Reduction Potential (ORP)

ORP (redox) of groundwater is a measure of electron activity and is an indicator of the relative tendency of a solution to accept or transfer electrons. In general, a groundwater ORP of less than negative 100 millivolts (mV) indicates that a reductive pathway is likely (USEPA, 1998). However, while ORP can indicate the likelihood of reductive dechlorination occurring, the aquifer redox condition cannot predict the extent to which reductive dechlorination will occur (Löffler et al., 1999). At the Facility, ORP in groundwater was measured to be lower than negative 100 mV in several areas where chlorinated compounds were detected.

3.1.3 Carbon Source

Because chlorinated compounds are utilized as electron acceptors during reductive dechlorination, an appropriate carbon source is required for microbial growth (and resulting production of hydrogen) to occur. Potential carbon sources include low molecular weight organic compounds (lactate, acetate, methanol, glucose, etc.), fuel hydrocarbons, or naturally occurring organic matter. At the Facility the geology of the shallow surficial soil consists of silts and clays of lacustrine (lake) origin with a high organic content. Additionally, anthropogenic carbon sources (fuel hydrocarbons such as fuel oil, jet fuel, and cutting oil) are present at the Facility in several areas where chlorinated compounds were detected.

3.1.4 Competing Electron Acceptors

Dissolved oxygen (DO) is the most favored electron acceptor used by microbes for the biodegradation of organic carbon. Anaerobic bacteria generally cannot function at DO concentrations greater than about 0.5 milligrams per liter (mg/L) and, hence, reductive dechlorination will not occur (USEPA, 1998). After depletion of DO, anaerobic microbes will use nitrate as an electron acceptor, followed by iron (III), sulfate, and finally carbon dioxide (methanogenesis). Each sequential reaction drives the ORP of the groundwater downward. Reductive dechlorination typically requires a redox state at least as anaerobic as sulfate reduction.

Excess concentrations of nitrate (greater than one mg/L) and sulfate (greater than 20 mg/L) may cause competitive exclusion of dechlorination. At the Facility, nitrate and sulfate concentrations in groundwater were generally measured to be lower than these potential competitive levels in the areas where chlorinated compounds were detected.

3.2 Enhanced Bioremediation

Enhanced bioremediation is the process of increasing the rate of contaminant degradation through the addition of nutrients or additives that produce conditions supportive of the natural biodegradation process. HRC, a proprietary polylactate ester manufactured by Regenesys, Inc., is a viscous liquid specially formulated for slow release of lactic acid upon contact with water in the subsurface environment. Lactic acid can be metabolized by native microbes to hydrogen, which is a suitable electron donor for the reductive dechlorination process (Koenigsberg and Farone, 1999).

4.0 Pilot Test Implementation

4.1 Pilot Area Selection

The pilot test area selected was at the Scrap Metal Recycling Dock at the Fabrication Operations Facility. Chlorinated aliphatic hydrocarbons compounds (TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and VC) were detected in the shallow groundwater at the Recycling Dock along with total petroleum hydrocarbons (TPH). The presence of cis-DCE and VC, compounds not known to have been historically used at the Facility, indicated that reductive dechlorination was naturally occurring in this area with potentially TPH being utilized as a carbon source.

The Scrap Metal Recycling Dock is located west of Building 27 (Figure 2-1) and consists of a concrete lined and curbed area approximately 250 feet long by 30 feet wide where aluminum, titanium, and other metal shavings and scrap from the manufacturing process are loaded into tractor trailers to be hauled off-site to a recycling company. The metal shavings contain cutting oil (currently water based) that is allowed to drain from the trailers into the curbed area prior to shipment. The cutting fluid is collected in a sump that is connected to a series of drain inlets in the concrete pad.

Monitoring Well MW3, located within the concrete curbed area in the Recycle Dock, was installed in July 2000 as part of the RFI. Groundwater from this well was sampled once (at installation) for TPH with a concentration of 1,700 micrograms per liter ($\mu\text{g/L}$) gasoline range TPH detected. Well MW3 was sampled for volatile organic compounds (VOCs) seven times during quarterly groundwater sampling prior to the pilot test implementation. PCE has never been detected in MW3. TCE concentrations detected in these seven samples ranged between 1,400 $\mu\text{g/L}$ to 8,000 $\mu\text{g/L}$ with an average concentration of approximately 4,000 $\mu\text{g/L}$. Cis-DCE concentrations ranged from 1,800 to 7,600 $\mu\text{g/L}$ with an average concentration of approximately 3,700 $\mu\text{g/L}$. VC concentrations ranged from 32 $\mu\text{g/L}$ to 130 $\mu\text{g/L}$ with several non-detects at a detection limit of 100 $\mu\text{g/L}$. The average VC concentration detected was approximately 87 $\mu\text{g/L}$. The only other VOCs detected in MW3 were low concentrations of 1,1-dichloroethane (DCA), 1,1-DCE, and trans-DCE which were detected in some of the sampling events. The results of the pre-pilot test groundwater sampling for MW3 are summarized in Table 4-1 and presented graphically in Figure 4-1. Linear curve matching trend lines for each chlorinated compound indicated no increasing or decreasing trends during the two-year period. A complete summary of groundwater sampling analysis and copies of laboratory reports can be found in the Draft RFI report (MACTEC, 2003).

4.2 Pilot Test Design

An area approximately 625 square feet with monitoring well MW3 at the center was chosen as the pilot test area. An injection grid consisting of three rows of three injection borings set 10 feet apart with the middle row staggered 5 feet to the north was planned. The injection grid was located such that MW3 was approximately five feet downgradient (east) of the middle grid row. Due to the location of an underground fire protection water line, the downgradient row of injection borings was located approximately 15 feet east of the center row (Figure 4-2).

The average TCE, cis-DCE and VC concentrations detected in monitoring well MW3, along with additional competing electron acceptor values and additional demand factors such as competing microbial processes and hydrophobic sorbtion were used to calculate the appropriate HRC application rate. Based on the software program provided by Regenesys, an appropriate application rate of 6 pounds per foot in each injection boring was estimated.

In order to provide for monitoring of groundwater upgradient and downgradient of the pilot test area, two additional monitoring wells were installed at the Recycling Dock on June 10, 2002. Monitoring Well MW3A was installed 29 feet west (upgradient) of MW3 and MW3B was installed 24 feet east (downgradient) of MW3 (Figure 4-2). Construction of these two monitoring wells matched that of MW3 except that 15 feet of well screen was used in each instead of 10 feet. MW3A and MW3B were drilled to a depth of 20 feet bgs and completed with 15 feet of two-inch schedule 40 polyvinyl chloride (PVC), 0.001-inch slotted well screen and solid PVC riser to the surface. Sand pack was placed to two feet above the top of the well screen with a one foot bentonite seal on top of the sand pack. The wells were completed at the surface with flush mount well boxes with one-foot skirts set into concrete. Copies of the boring/monitoring well logs for MW3, MW3A, and MW3B are included as Appendix A.

Based on the design of the pilot test presented in the Pilot Test Work Plan, Boeing obtained an Underground Injection Control permit from the Missouri Department of Natural Resources Clean Water Commission for the pilot test project. A copy of the permit is included as Appendix B.

4.3 HRC Injection

PSA Environmental of Lee's Summit, Missouri conducted the HRC injection on July 19, 2002 under the direction of a MACTEC geologist. A truck mounted Geoprobe® hydraulic soil probing machine was used to install the injection borings using 1.5-inch diameter steel drive rod fitted with an expendable steel point. Each boring was driven to 19 feet bgs and the drill rod was retracted in approximately 1-foot intervals to 4 feet bgs. In two of the borings, a prototype injection drive rod head was used to allow injection in 1-foot intervals during the downward probing. Approximately six pounds of HRC was injected at each 1-foot interval for a total of 90

pounds per injection boring. The HRC material in 4-gallon buckets (30 pounds of HRC) was heated in a water bath to an approximate temperature of 120° Fahrenheit (°F) to increase the viscosity of the HRC. A Geoprobe® GS2000 pump was used to pump the HRC down the drive rods.

Following completion of HRC injection and removal of the drive rod, each boring was temporarily plugged with a four-foot section of 2x2 wood to keep the HRC from pushing back up the open borehole. After one to two hours, the fluid pressure dissipated, and the boreholes were capped with granular bentonite and the concrete surface patched.

4.4 Groundwater Monitoring

Groundwater samples were collected from the three monitoring wells (MW3, MW3A, and MW3B) the day prior to the HRC injection and monthly thereafter for the next year. A final round of groundwater sampling was conducted in January 2004, 19 months after the HRC injection. Groundwater samples were analyzed VOCs by EPA Method 8260.

Quarterly the groundwater samples were analyzed by the laboratory for 14 inorganic parameters: chloride; dissolved organic carbon (DOC); total organic carbon (TOC); ethane; ethene; free carbon dioxide; iron; dissolved iron; dissolved manganese; methane; nitrate; nitrite; sulfate; and sulfide. Additionally, the groundwater samples were analyzed quarterly for five metabolic acids: lactic acid, pyruvic acid, acetic acid, propionic acid, and butyric acid. These acids are indicators of the breakdown of the HRC. Copies of the laboratory reports and chain-of-custody documents for the January 2004 sampling event and the metabolic acid analysis are included in Appendix C. Copies of laboratory reports for the previous VOC analysis are included in the RFI (MACTEC, 2003).

Groundwater samples were collected using a peristaltic pump and dedicated tubing. When possible, the samples were collected using low flow sampling techniques (USEPA, 1996). If drawdown could not be stabilized in a well, the well was sampled after the removal of three well volumes of groundwater and the stabilization of field parameters. Field parameters measured were temperature, pH, conductivity, redox potential (ORP), DO, and ferrous iron.

Immediately upon collection, each sample was properly labeled to prevent misidentification and placed in a shipping container with sufficient ice or ice packs to maintain an internal temperature of four-degrees Celsius (°C) during transport to the laboratory. A completed chain-of-custody form was placed in each shipping container to accompany the samples to the laboratory. VOC and inorganic analysis were conducted by Environmental Science Corporation in Mt. Juliet, Tennessee. Metabolic acid analysis was conducted by Keystone Laboratories in Newton, Iowa.

4.5 Pilot Study Site Disturbance

On November 20, 2002 (154 days following HRC injection) the underground fire protection water line that runs through the Scrap Metal Recycling Dock failed, resulting in a release of an unknown volume of water. The water line runs through the pilot test area, between the center and east rows of injection points. The water line break occurred approximately 30 feet south of the pilot test area and was repaired within 24 hours by excavating an area approximately 20 feet long (north-south) by 10 feet wide (east-west). The monthly groundwater sampling of the pilot test wells was conducted on November 22, 2002.

5.0 Results

A summary of the target VOC analytical results from the pilot test groundwater samples are presented in Table 5-1 and on Figure 5-1. Results of target VOC analytical molar data and molar ratio data are presented in Tables 5-2 and 5-3 and on Figure 5-2. A summary of inorganic analytical analysis is presented in Table 5-4 and on Figure 5-3. A summary of field parameter measurements is presented in Table 5-5 and on Figure 5-4. Results of metabolic acid analysis are presented in Table 5-6.

5.1 Upgradient Well

Monitoring Well MW3A was installed approximately 15 feet upgradient of the HRC injection grid. The results of VOC analysis indicate that chlorinated compound concentrations stayed the same or slightly increased over the 19-month pilot study. TCE concentrations ranged from 150 µg/L to 290 µg/L, cis-DCE concentrations ranged from 160 µg/L to 460 µg/L, trans-DCE concentrations ranged from less than one µg/L to 18 µg/L, and VC concentrations ranged from less than one µg/L to 13 µg/L.

Inorganic analysis and field parameter measurement indicated no discernible trends over the 19-month pilot test with the exception of a one-time drop in the ORP measurement corresponding with the break of the water line just south of the pilot test area. The ORP measurement returned the following month to the normal observed range.

5.2 VOC Analysis

The results of laboratory VOC analysis indicated that TCE concentrations declined 98 percent in MW3 by the first sampling event at 28 days post injection and were more than 99 percent lower through each of the subsequent 11 months. TCE concentration in MW3 at 19-months remained 98.7 percent lower than prior to injection. TCE concentrations declined 100 percent in MW3B by the first sampling event at 28 days post injection and remain below detection limit at 19-months.

The decline in TCE in MW3 was matched by an initial increase in cis-DCE over the first two months after injection. Three months after injection, cis-DCE concentrations declined significantly in MW3 and MW3B with a corresponding increase in vinyl chloride. The vinyl chloride concentration increased in MW3 through the eighth month of the pilot test (February 2003) and declined over the following eight months. The vinyl chloride concentration in MW3B declined each month starting with eighth month after injection.

5.3 Molar Ratio

In an attempt to evaluate the degradation process molar ratio percentages of the chlorinated VOCs through time were assessed. Molar ratios between parent compound and daughter product should remain constant if no biodegradation is occurring. Molar ratio percentages provide a view of the relative proportions of an analyte to the sample as a whole. The total number of moles of organic compounds in a sample is the sum of the moles for each of the analytes (Table 5-2). In order to obtain the molar ratio percentage the concentration of the analyte is divided by its molecular weight to give the number of moles of that analyte in the sample. The molar ratio percentage is obtained by dividing the number of moles of an analyte by the total number of moles of organic compounds in the sample (Table 5-3). Only the targeted analytes (TCE, cis-DCE, and VC) were included in this molar ratio percentage evaluation.

Figure 5-2 presents a graphical presentation of the molar percentages for the analytical results. Monitoring Well MW3A, the upgradient well, shows relatively consistent molar ratio composition throughout the pilot test. Wells MW3 and MW3B both show a decrease in the percentage of TCE after the first 30 days and an increase in the percentage of VC between the third and ninth months post injection with a decrease in VC percentage throughout the remainder of the pilot test, indicative of enhanced reductive dechlorination.

5.4 Inorganic Analysis

A summary of inorganic analysis for the three wells in the pilot test in addition to one non-impacted monitoring well (MW9S) located nearby (approximately 150 feet away) is presented in Table 5-4. Five inorganic compounds useful in the evaluation of the reductive dechlorination stimulated by the injection of HRC at the pilot test area are graphed on Figure 5-3. Ethene was detected in MW3 in both the nine-month and 12-month sampling events and ethane was detected in the nine month sampling, corresponding with the observed decrease in VC, further evidence of the complete dechlorination of VC. The inorganic analysis observed suggests that the effect of the HRC in MW3 began to decline between nine and 12 months post injection as indicated by the slight increase of sulfate concentrations and the return of TOC concentrations to background levels. However, the results of VOC analysis and field parameter measurement indicate that conditions remain favorable for reductive dechlorination and that chlorinated compound degradation is continuing.

5.5 Field Parameters

Field parameters measurements were collected each sampling event and are summarized in Table 5-5. The pH, specific conductivity, and ferrous iron content remained generally consistent in MW3 and MW3B over the course of the pilot test. The DO declined in both MW3 and MW3B

and remained below the pre-injection value with the exception for an increase in DO for approximately 30 days following the water line break. ORP declined in both MW3 and MW3B and remained below the pre-injection value for the duration of the pilot test, although the OPR levels did increase slightly in MW-3 and MW-3B following the water line break.

5.6 Metabolic Acid Analysis

HRC is a polylactic ester that breaks down into volatile acids: acetic, butyric, lactic, propionic, and pyruvic. Metabolic analysis indicated that acids were not detected in the four post injection quarterly sampling events. Additionally, lactic acid was not detected in a groundwater sample collected from well MW3 in October 2001. Lactic acid was detected in the sampling conducted on monitoring well MW3 immediately prior to the injection, this anomalous result may be the result of cross-contamination or laboratory error. The lack of detectable acid concentrations in the post injection sampling may indicate that HRC was quickly being completely broken down to levels below the laboratory detection limit.

6.0 Conclusions

The results of the pilot test provide definitive evidence that reductive dechlorination is occurring within the test area and that the injection of HRC greatly accelerated the rate of chlorinated compound degradation.

- The dechlorination process was observed to go to completion with the reduction of TCE → cis-DCE → VC → ethene → ethane. Clear evidence that reductive dechlorination was going to completion was the detection of ethene and/or ethane in MW-3 in the two samples (March and June of 2003) analyzed for these constituents following the onset of vinyl chloride reduction in the well. Note that ethane and ethene was not detected in January 2004 but that the method detection limit was elevated (10 mg/L) for this analysis. Additionally, the low concentration of vinyl chloride present in MW-3B, would probably preclude the detection of ethane or ethene above the method detection limit of one mg/L.
- Additional evidence that complete dechlorination is occurring is that the vinyl chloride concentrations remained unchanged between the June 2003 and January 2004 sampling event in MW-3 while the cis-DCE concentration declined in this well by 37 percent. Since the vinyl chloride concentration did not change over this period, the vinyl chloride that was created by the reduction of the cis-DCE was offset by the dechlorination of vinyl chloride.
- Based on the reduction in TOC concentrations to pre-injection levels and the slight increase in sulfate observed in monitoring well MW3, the majority of HRC may have been consumed by the 12th month. However, the conditions for reductive dechlorination (low DO, redox potential, and limited competing electron donors) remain and that reductive dechlorination is still occurring as evidenced by the continued chlorinated compound degradation observed through the 19th month in both monitoring wells MW3 and MW3B.
- Groundwater immediately upgradient to the pilot area was unaffected by the pilot test. However, the VOC concentrations present in the upgradient well (MW3A) are an order of magnitude or more lower than the concentrations present prior to the pilot test in MW3 and continued reductive dechlorination is expected as the groundwater migrates into the anaerobic conditions of the pilot test area.
- The DO went up in monitoring wells MW-3 and MW-3B in the samples collected immediately after and 30 days after the water line break. This increase in DO is most likely the result of influence from the water line break and may have temporarily slowed the reductive dechlorination process. However, the DO levels in these two wells returned to low levels in the sampling conducted approximately 60 days after the line break and remained at favorably low levels for the remainder of the pilot test. Therefore, the water line break did not appear to have any long term effect on the results of the pilot test.

- The graphs of the detected VOC constituents provide indirect evidence that desorption of TCE from the soil below the groundwater table occurred for a period of time in monitoring well MW3. Given that TCE tends to degrade faster than DCE, if desorption is occurring, DCE will build up in the system over time. Initially, DCE concentrations rose in well MW3 over the first two months post injection, consistent with the observed rapid degradation of TCE in groundwater. The DCE concentrations declined significantly between the second and third month as the DCE was reduced at a faster rate than it was produced. TCE in groundwater had declined by more than 99 percent over this time. DCE concentrations started to go up beginning the fourth month through the 12th month indicating that DCE was being produced at a rate higher than it was degraded, most likely by the degradation of TCE desorbed from the soil. DCE concentrations fell between the 12th and 19th month indicating that TCE desorption was declining as TCE was removed from the soil.
- This trend of DCE build up was not observed in the downgradient well (MW3B) which indicates that desorption of TCE from the soil was not occurring at that location. Note that well MW3B is located outside of the source area (inside the curbed area at the Recycle Dock) and that screening of soil samples collected during the drilling of MW3B did indicate the presence of organic vapors in the soil.

7.0 References

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Tables

Table 4-1 Summary of Laboratory Pre-Pilot Test Target VOC Data (µg/L), Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

Injection Date: 06/19/02								
Well ID	Sampling Date	07/28/2000	01/10/2001	05/09/2001	07/24/2001	10/25/2001	03/06/2002	06/18/2002
	Days Since Injection	-691	-525	-406	-330	-237	-105	-1
	Parameter	Results (µg/L)						
MW3	PCE	<100	<5	<100	<1	<25	<1	<100
	TCE	1,700	6,900	3,500	2,700	8,000	1,400	3,900
	cis-1,2-DCE	2,100*	6,000	2,600	2,600	7,600	1,800	3,300
	trans-1,2-DCE	NA	91	<100	62	260	67	<100
	VC	32	120	<100	81	130	75	<100
	Total VOC	1,732	13,111	6,100	5,443	15,990	3,342	7,200

MACTEC, 2004

Notes:

PCE - Tetrachloroethene
TCE - Trichloroethene
cis-1,2-DCE - cis-1,2-Dichloroethene
VC - Vinyl chloride
* - Result of total 1,2-DCE analysis

VOC - Volatile Organic Compound
NA - Not analyzed
< - Not detected above the indicated concentration
µg/L - micrograms per liter

Table 5-1 Summary of Laboratory Target VOC Data (µg/L), Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

Well ID	Injection Date: 06/19/2002															Percent Change
	Sampling Date	06/18/2002	07/18/2002	08/15/2002	09/23/2002	10/15/2002	11/22/2002	12/16/2002	01/20/2003	02/20/2003	03/17/2003	04/17/2003	05/19/2003	06/18/2003	01/14/2004	
	Days Since Injection	-1	29	57	96	118	156	180	215	246	271	302	334	364	574	
Parameter		Results (µg/L)														
MW3A	PCE	<1	<1	<1	<1	<5	<1	<10	<1	<1	<1	<1	<1	<1	<1	0%
	TCE	190	220	240	150	170	190	230	240	220	220	150	220	260	290	52.6%
	cis-1,2-DCE	160	240	270	200	260	290	320	340	290	270	220	320	360	460	187.5%
	trans-1,2-DCE	9.8	12	14	12	10	12	14	17	12	14	11	18	18	<1	-100.0%
	VC	4.9	5.9	5.3	4.8	6	7.5	<10	6.7	9.3	7.1	8.9	8.7	9.9	13	165.3%
	Total VOC	364.7	477.9	529.3	366.8	446	499.5	564	603.7	519.3	497.1	389.9	566.7	647.9	763	109.2%
MW3	PCE	<100	<50	<50	<1	<5	<25	<5	<1	<1	<1	<50	<5	<1	<1	0%
	TCE	3,900	210	51	8	<5	33	5.8	5.2	9.7	6.4	<50	9.1	7.3	34.0	-98.7%
	cis-1,2-DCE	3,300	3,800	4,900	1,300	2,200	2,100	1,600	2,300	2,700	2,700	2,900	3,600	4,100	2,600	-21.2%
	trans-1,2-DCE	<100	73	110	34	44	39	47	54	59	53	<50	77	68	100	0.0%
	VC	<100	<50	84	440	1,400	1,100	1,300	1,600	2,700	2,100	1,600	1,400	1,000	1,000	3900%
	Total VOC	7,200	4,083	5,145	1,782	3,644	3,272	2,953	3,959	5,410	4,806	4,500	5,086	5,175	3,734	-48.1%
MW3B	PCE	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0%
	TCE	8.5	2.1	<2	<1	<1	1.1	<1	<1	<1	<1	<1	<1	<1	<1	-100.0%
	cis-1,2-DCE	130	100	86	65	53	30	27	27	19	15	13	16	16	6.2	-95.2%
	trans-1,2-DCE	2.7	1.7	<2	1.5	1.5	1.4	1.4	1.5	<1	1.1	<1	<1	1.1	<1	-100.0%
	VC	1.2	<1	<2	2.5	15	15	11	15	12	7.7	6.4	5.8	4.2	1.8	50.0%
	Total VOC	142.4	103.8	86	69	69.5	47.5	39.4	43.5	31	22.7	19.4	21.8	21.3	8	-94.4%

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Notes:

PCE - Tetrachloroethene
TCE - Trichloroethene
cis-1,2-DCE - cis-1,2-Dichloroethene
trans-1,2-DCE - trans-1,2-Dichloroethene

VC - Vinyl chloride
VOC - Volatile Organic Compound
µg/L - micrograms per liter
< - Not detected above the indicated concentration

Table 5-2 Summary of Target VOC Molar Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	Injection Date: 06/19/02															
Well ID	Sampling Date		06/18/02	07/18/02	08/15/02	09/23/02	10/15/02	11/22/02	12/16/02	01/20/03	02/20/03	03/17/03	04/17/2003	05/19/2003	06/18/2003	01/14/2004
	Days Since Injection		-1	29	57	96	118	156	180	215	246	271	302	334	364	574
	Parameter	mol. Wt. (g/mol)	Results (µmol/L)													
MW3A	PCE	165.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TCE	131.39	1.4	1.7	1.8	1.1	1.3	1.4	1.8	1.8	1.7	1.7	1.1	1.7	2.0	2.2
	cis-1,2-DCE	96.94	1.7	2.5	2.8	2.1	2.7	3.0	3.3	3.5	3.0	2.8	2.3	3.3	3.7	4.7
	VC	62.50	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2
	Total		3.2	4.2	4.7	3.3	4.1	4.6	5.1	5.4	4.8	4.6	3.6	5.1	5.9	7.2
MW3	PCE	165.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TCE	131.39	29.7	1.6	0.4	0.1	0.0	0.3	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.3
	cis-1,2-DCE	96.94	34.0	39.2	50.5	13.4	22.7	21.7	16.5	23.7	27.9	27.9	29.9	37.1	42.3	26.8
	VC	62.50	0.0	0.0	1.3	7.0	22.4	17.6	20.8	25.6	43.2	33.6	25.6	22.4	16.0	16.0
	Total		63.7	40.8	52.3	20.5	45.1	39.5	37.3	49.4	71.1	61.5	55.5	59.6	58.3	43.1
MW3B	PCE	165.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TCE	131.39	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	cis-1,2-DCE	96.94	1.3	1.0	0.9	0.7	0.5	0.3	0.3	0.3	0.2	0.2	0.1	0.2	0.2	0.1
	VC	62.50	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.0
	Total		1.4	1.0	0.9	0.7	0.7	0.5	0.4	0.4	0.3	0.2	0.2	0.2	0.2	0.1

MACTEC, 2004

Notes:

cis-1,2-DCE - cis-1,2-Dichloroethene
g/mol - grams per mole
µmol/L - micromole per liter

PCE - Tetrachloroethene
TCE - Trichloroethene
VC - Vinyl chloride

a. - For those results less than the laboratory reporting limit, numeric zeros were listed as results and were used for graphing purposes. Detection limits are subject to variation due to sample matrix interference and sample dilution.

Table 5-3 Summary of Target VOC Molar Percentage Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

Injection Date: 06/19/02																
Well ID	Sampling Date		06/18/02	07/18/02	08/15/02	09/23/02	10/15/02	11/22/02	12/16/02	01/20/03	02/20/03	03/17/03	04/17/03	05/19/03	06/18/03	01/14/04
	Days Since Injection		-1	29	57	96	118	156	180	215	246	271	302	334	364	574
	Parameter	mol. Wt. (g/mol)	Percent (%) of Total Moles													
MW3A	PCE	165.83	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	TCE	131.39	45.55%	39.45%	38.89%	34.79%	31.78%	31.73%	34.65%	33.57%	34.78%	36.61%	32.13%	32.74%	33.82%	30.83%
	cis-1,2-DCE	96.94	51.98%	58.33%	59.30%	62.87%	65.87%	65.64%	65.35%	64.46%	62.13%	60.90%	63.86%	64.54%	63.47%	66.27%
	VC	62.50	2.47%	2.22%	1.81%	2.34%	2.36%	2.63%	0.00%	1.97%	3.09%	2.48%	4.01%	2.72%	2.71%	2.91%
	Total		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
MW3	PCE	165.83	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	TCE	131.39	46.58%	3.92%	0.74%	0.30%	0.00%	0.64%	0.12%	0.08%	0.10%	0.08%	0.00%	0.12%	0.10%	0.60%
	cis-1,2-DCE	96.94	53.42%	96.08%	96.69%	65.38%	50.32%	54.82%	44.19%	48.06%	39.16%	45.29%	53.89%	62.30%	72.48%	62.26%
	VC	62.50	0.00%	0.00%	2.57%	34.32%	49.68%	44.54%	55.69%	51.86%	60.74%	54.63%	46.11%	37.58%	27.42%	37.14%
	Total		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
MW3B	PCE	165.83	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	TCE	131.39	4.54%	1.53%	0.00%	0.00%	0.00%	1.77%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	cis-1,2-DCE	96.94	94.11%	98.47%	100.00%	96.30%	77.94%	65.49%	71.05%	64.29%	61.29%	66.08%	67.01%	73.39%	79.21%	77.50%
	VC	62.50	1.35%	0.00%	0.00%	3.70%	22.06%	32.74%	28.95%	35.71%	38.71%	33.92%	32.99%	26.61%	20.79%	22.50%
	Total		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

MACTEC, 2004

Notes:

PCE - Tetrachloroethene
TCE - Trichloroethene
cis-1,2-DCE - cis-1,2-Dichloroethene

VC - Vinyl chloride
g/mol - Grams per mole
mol. Wt. - Molecular weight

a. - For those results less than the laboratory reporting limit, numeric zeros were listed as results and were used for graphing purposes. Detection limits are subject to variation due to sample matrix interference and sample dilution.

Table 5-4 Summary of Laboratory Groundwater Quality Parameter Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

Well ID	Injection Date: 06/19/2002											
	Sampling Date‡	01/10/2001	05/09/2001	07/24/2001	10/25/2001	03/06/2002	06/18/2002	08/15/2002	12/16/2002	03/17/2003	06/18/2003	01/14/2004
	Days Since Injection	-525	-406	-330	-237	-105	-1	57	180	271	364	574
	Parameter	Results (mg/L)										
MW3A	Chloride	NI	NI	NI	NI	NI	480	640	610	550	690	690
	DOC	NI	NI	NI	NI	NI	2.3	1.1	1.7	1.0	1.2	2.6
	TOC	NI	NI	NI	NI	NI	2.2	1.1	1.6	1.4	1.2	1.4
	Ethene	NI	NI	NI	NI	NI	<1	<1	<1	<1	<1	<10
	Ethane	NI	NI	NI	NI	NI	<1	<1	<1	<1	<1	<10
	Methane	NI	NI	NI	NI	NI	<1	<1	<1	<1	<1	<1
	Manganese (dissolved)	NI	NI	NI	NI	NI	1.2	1.3	0.73	0.84	0.8	0.96
	Iron (total)	NI	NI	NI	NI	NI	0.89	74	0.037	0.069	0.053	<0.050
	Iron (dissolved)	NI	NI	NI	NI	NI	<0.02	0.22	<0.02	<0.05	<0.05	0.053
	Nitrate (as N)	NI	NI	NI	NI	NI	0.48	<0.1	0.288	<0.1	0.19	<0.1
	Nitrite (as N)	NI	NI	NI	NI	NI	<0.1	<1.0	<2.5	<0.1	<0.1	<0.1
	Sulfate	NI	NI	NI	NI	NI	85	95	95.9	95	92	92
	Sulfide	NI	NI	NI	NI	NI	<0.10	<0.02	<0.02	<0.05	<0.05	<0.05
	Free Carbon Dioxide	NI	NI	NI	NI	NI	150	120	160	170	130	180
MW3	Chloride	417	395	460	490	580	450	430	590	530	530	480
	DOC	<1	1.8	1.6	1	<1	1.8	7.1	2.3	1.6	1.4	2.0
	TOC	1	1.85	1.7	1.2	1	1.6	7.2	2.5	2.1	<1.0	1.7
	Ethene	NA	NA	NA	NA	<1	<1	<1	<1	1.3	7.9	<10
	Ethane	NA	NA	NA	NA	<1	<1	<1	<1	1.2	<1	<10
	Methane	NA	NA	NA	NA	<1	<1	<1	<1	78	<1	1.6
	Manganese (dissolved)	NA	NA	NA	NA	NA	2.1	1.8	1.9	2.0	1.9	2.1
	Iron (total)	3.4	4	NA	5.5	5.6	4.9	5.6	5.5	5.8	5.3	5.8
	Iron (dissolved)	NA	NA	NA	NA	NA	<0.02	<0.02	0.051	0.78	1.1	0.7
	Nitrate (as N)	<0.03	<0.1	0.2	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Nitrite (as N)	<0.03	<0.1	<0.1	<0.1	<1	<0.1	<1.0	<2.5	<0.1	<0.1	<0.1
	Sulfate	73.9	80	80	86	87	87	30	22.6	28	39	41
	Sulfide	NA	NA	NA	NA	NA	<0.1	<0.02	<0.02	<0.05	<0.05	0.077
	Free Carbon Dioxide	NA	NA	NA	NA	100	150	110	130	110	120	140
MW3B	Chloride	NI	NI	NI	NI	NI	840	870	830	870	1,000	1,400
	DOC	NI	NI	NI	NI	NI	1.6	1.3	1.6	1.2	<1	1.4
	TOC	NI	NI	NI	NI	NI	1.4	<1	1.4	1.1	<1	<1
	Ethene	NI	NI	NI	NI	NI	<1	<1	<1	<1	<1	<10
	Ethane	NI	NI	NI	NI	NI	<1	<1	<1	<1	<1	<10
	Methane	NI	NI	NI	NI	NI	<1	<1	<1	<1	<1	<1
	Manganese (dissolved)	NI	NI	NI	NI	NI	5.5	4.9	4.9	5.3	5.2	6.7
	Iron (total)	NI	NI	NI	NI	NI	5.7	12	8.3	11	12	16
	Iron (dissolved)	NI	NI	NI	NI	NI	0.63	0.06	0.8	5.4	7.9	11
	Nitrate (as N)	NI	NI	NI	NI	NI	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Nitrite (as N)	NI	NI	NI	NI	NI	<1.0	<1.0	<2.5	<0.5	<0.2	<0.1
	Sulfate	NI	NI	NI	NI	NI	38	32	29.1	31	34	33
	Sulfide	NI	NI	NI	NI	NI	<0.10	<0.02	<0.02	<0.05	<0.05	<0.05
	Free Carbon Dioxide	NI	NI	NI	NI	NI	89	120	110	88	77	120
MW9S	Chloride	NS	NS	NS	NS	NS	5,200	5,200	5,500	5,200	5,400	NS
	DOC	NS	NS	NS	NS	NS	<1	1.4	1.6	1.4	1.3	NS
	TOC	NS	NS	NS	NS	NS	<1	1.5	1.5	1.8	<1	NS
	Ethene	NS	NS	NS	NS	NS	<1	<1	<1	<1	<1	NS
	Ethane	NS	NS	NS	NS	NS	<1	<1	<1	<1	<1	NS
	Methane	NS	NS	NS	NS	NS	<1	<1	<1	<1	<1	NS
	Manganese (dissolved)	NS	NS	NS	NS	NS	NA	NA	NA	6.4	4.9	NS
	Iron (total)	NS	NS	NS	NS	NS	NA	18	NA	18	17	NS
	Iron (dissolved)	NS	NS	NS	NS	NS	NA	NA	NA	16	0.3	NS
	Nitrate (as N)	NS	NS	NS	NS	NS	<1	<0.1	0.25	<0.1	<0.4	NS
	Nitrite (as N)	NS	NS	NS	NS	NS	<1	<10	<2.5	<0.1	<10	NS
	Sulfate	NS	NS	NS	NS	NS	140	140	150	140	150	NS
	Sulfide	NS	NS	NS	NS	NS	NA	NA	NA	<0.05	<0.05	NS
	Free Carbon Dioxide	NS	NS	NS	NS	NS	250	170	350	<10	180	NS

MACTEC, 2004

Notes:

DOC - Dissolved organic carbon

TOC - Total organic carbon

N - Nitrogen

mg/L - milligrams per liter

‡ - Samples may be collected on two consecutive days. The first day of sampling is used for the sampling date on this table and for the dates plotted on the attached figures.

< - Not detected above the indicated concentration

NI - Well not installed

NA - Not analyzed

NS - Not sampled

Table 5-5 Summary of Field Groundwater Quality Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	Injection Date: 06/19/2002																Optimum Value
Well ID	Collection Date‡	06/18/2002	07/18/2002	08/15/2002	09/23/2002	10/15/2002	11/22/2002	12/16/2002	01/20/2003	02/20/2003	03/17/2003	04/17/2003	05/19/2003	06/18/2003	01/14/2004		
	Days Since Injection	-1	29	57	96	118	156	180	215	246	271	302	334	364	574		
	Parameter	Results															
MW3A	Final pH	7.03	6.74	6.71	6.66	6.74	6.79	6.79	6.63	6.87	6.76	6.75	6.76	6.87	6.06	5 < pH < 9	
	Final Conductivity (uS)	2,380	2,510	2,810	2,830	2,720	2,840	2,240	2,840	2,650	2,840	2,820	2,860	2,850	2,990	NA	
	Final Temperature (C)	19.4	20.2	21.7	22.7	20.5	17.5	15.3	12.9	12.2	14.2	14.9	17.9	20.5	14.3	>20	
	Final Dissolved Oxygen (mg/L)	4.12	0	0.34	0.87	0.12	0.79	0.89	0.0	0.2	0.6	0.25	0.0	0.0	0.65	<0.5	
	Final ORP (mvolts)	64	-11	11	-14	74	-185	-7	115	100	46	60	47	18	26	< -100	
	Ferrous (Fe2+) Iron (mg/L)	0.4	0.8	0.0	NS	0.0	0.0	0.2	0.0	0.0	0.4	0.4	0.4	0.2	0.0	>1	
	Total Volume Purged (gallons)	8.0	9.0	9	13.5	3	3	2.5	2.25	2	3.25	4.5	2.5	3.5	2.5		
MW3	Final pH	6.88	6.80	6.75	6.72	6.78	6.81	6.81	6.76	6.78	6.79	6.95	6.83	6.88	7.34	5 < pH < 9	
	Final Conductivity (uS)	2,450	2,360	2,270	2,450	2,330	2,260	1,930	2,470	2,490	2,520	2,490	2,490	2,420	2,400	NA	
	Final Temperature (C)	20.1	22.3	21.8	22.0	22.0	20.1	16.3	15.4	15	15.3	15.1	18.4	20.9	16.8	>20	
	Final Dissolved Oxygen (mg/L)	0.34	0.0	0.2	0.52	0.0	1.28	1.44	0.0	0.07	0.0	0.31	0.0	0.0	0.25	<0.5	
	Final ORP (mvolts)	-40	-209	-145	-185	-237	-305	-151	-166	-139	-182	-151	-244	-183	-206	< -100	
	Ferrous (Fe2+) Iron (mg/L)	3.2	2.8	2.8	NS	2.6	3	2.2	3.4	2.4	1.6	2.8	3.0	3.4	NS	>1	
	Total Volume Purged (gallons)	2	1.3	7	1.5	2.5	7.5	1.5	2.5	2.5	2.5	2.5	1.5	2.0	7.5		
MW3B	Final pH	6.71	6.59	6.54	6.45	6.55	6.56	6.53	6.61	6.61	6.67	6.53	6.7	6.63	7.6	5 < pH < 9	
	Final Conductivity (uS)	3,400	3,320	3,470	3,550	3,410	3,310	2,580	3,390	3,220	3,550	3,600	3,630	3,760	4,290	NA	
	Final Temperature (C)	24.5	21.4	22.9	24.6	22.6	18.6	16.6	14.8	14.2	15.8	15.3	18.8	21.3	16.2	>20	
	Final Dissolved Oxygen (mg/L)	2.25	0.0	0.38	0.38	0.0	0.45	1.11	0.0	0.21	0.02	0.25	0.0	0.0	0.61	<0.5	
	Final ORP (mvolts)	23	-96	-84	-73	-79	-56	-99	-28	5	-43	-23	-69	-62	-50	< -100	
	Ferrous (Fe2+) Iron (mg/L)	2.4	2.6	2.2	NS	2.6	2.4	2.8	2.6	3.2	2	2.8	2.6	4.6	5.6	>1	
	Total Volume Purged (gallons)	2.8	8.8	9	1.5*	3	3.25	2.5	1.75	2.25	2.75	3.75	2.3	1.8	3.5		

MACTEC, 2004

MACTEC, 2004

Notes:

* - Volume not measured - estimated purge volume.

C - Degrees Celsius

uS - microsiemens

‡ Samples may be collected on two consecutive days. The first day of sampling is used for the sampling date on this table and for the dates plotted on the attached figures.

mvolts - millivolts

NS - Not sampled

NA - Not applicable

mg/L - milligrams per liter

ORP - Oxidation Reduction Potential

Bold - Indicates result in optimum value range

Table 5-6 Summary of Metabolic Acid Analysis Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

		Injection Date: 6/19/2002					
Well ID	Sampling Date ^a	10/25/2001	6/18/2002	9/23/2002	12/16/2002	3/18/2003	6/18/2003
	Days Since Injection	-236	-1	96	180	272	364
	Parameter	Results (mg/L)					
MW3A	Acetic Acid	NI	<1	<1	<1	<1	<1
	Butyric Acid	NI	<1	<1	<1	<1	<1
	Lactic Acid	NI	<1	<1	<1	<1	<1
	Propionic Acid	NI	<1	<1	<1	<1	<1
	Pyruvic Acid	NI	<0.1	<0.1	<0.1	<0.1	<0.1
MW3	Acetic Acid	NA	<1	<1	<1	<1	<1
	Butyric Acid	NA	<1	<1	<1	<1	<1
	Lactic Acid	<1	26.6	<1	<1	<1	<1
	Propionic Acid	NA	<1	<1	<1	<1	<1
	Pyruvic Acid	NA	<0.1	<0.1	<0.1	<0.1	<0.1
MW3B	Acetic Acid	NI	<1	<1	<2	<1	<1
	Butyric Acid	NI	<1	<1	<2	<1	<1
	Lactic Acid	NI	<1	<1	<2	<1	<1
	Propionic Acid	NI	<1	<1	<2	<1	<1
	Pyruvic Acid	NI	<0.1	<0.1	<0.2	<0.1	<0.1

MACTEC, 2004

Notes:

- < - Not detected above the indicated concentration
- NI - Well not installed
- NA - Not analyzed
- a. - Samples may be collected on separate days. The date that MW3 was sampled is used for the sampling date on this table and for the dates plotted on the attached figures.
- mg/L - milligrams per liter

Figures

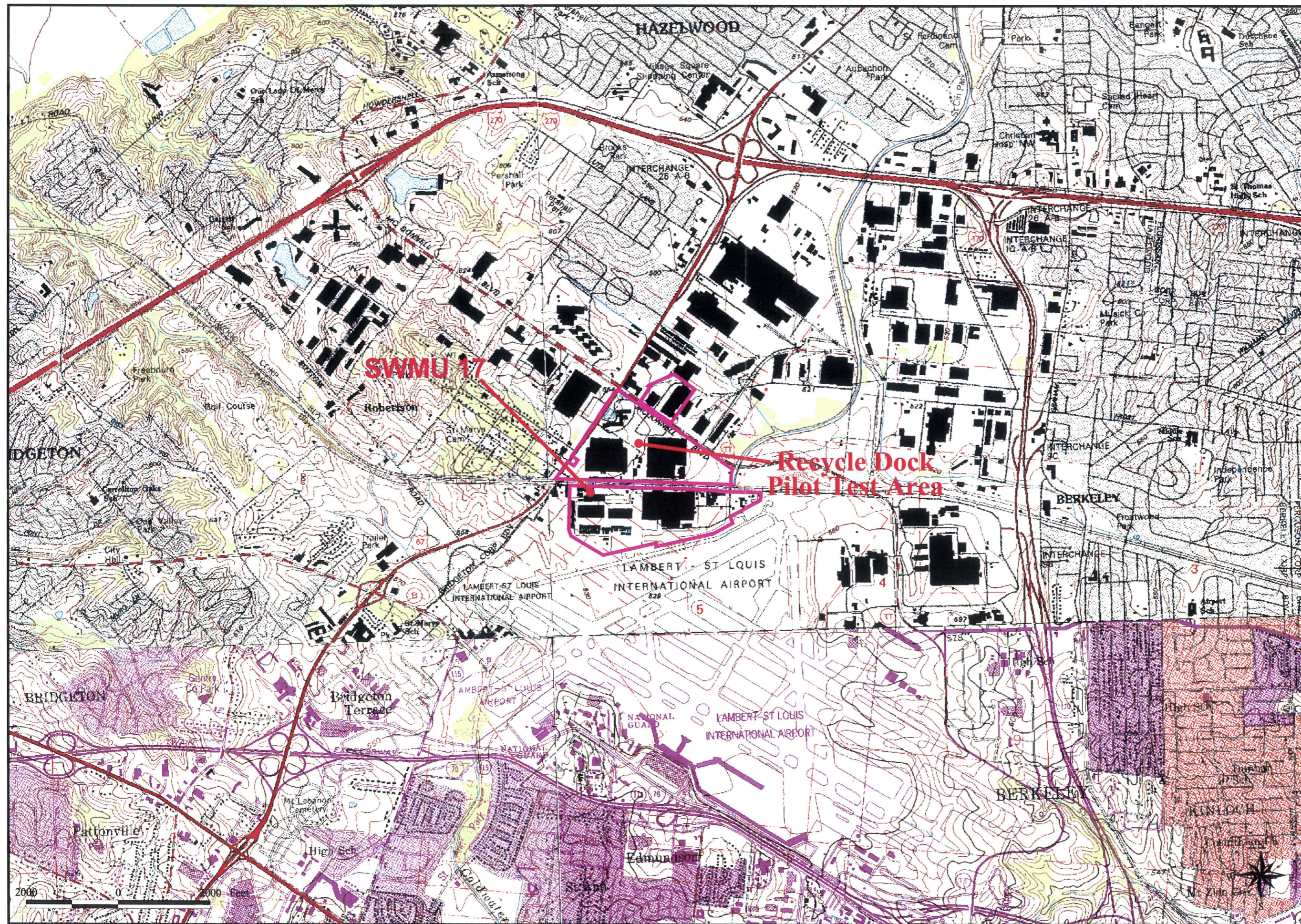


Figure 1-1
Facility Location Map
Enhanced Bioremediation
Pilot Test
Boeing Tract 1,
Hazelwood, Missouri

Legend

 Boeing Tract 1

Source: USGS Clayton,
Creve Coeur, Florissant,
and St. Charles 7.5 Minute
Quads.

Scale

1:24000

1" = 2000'

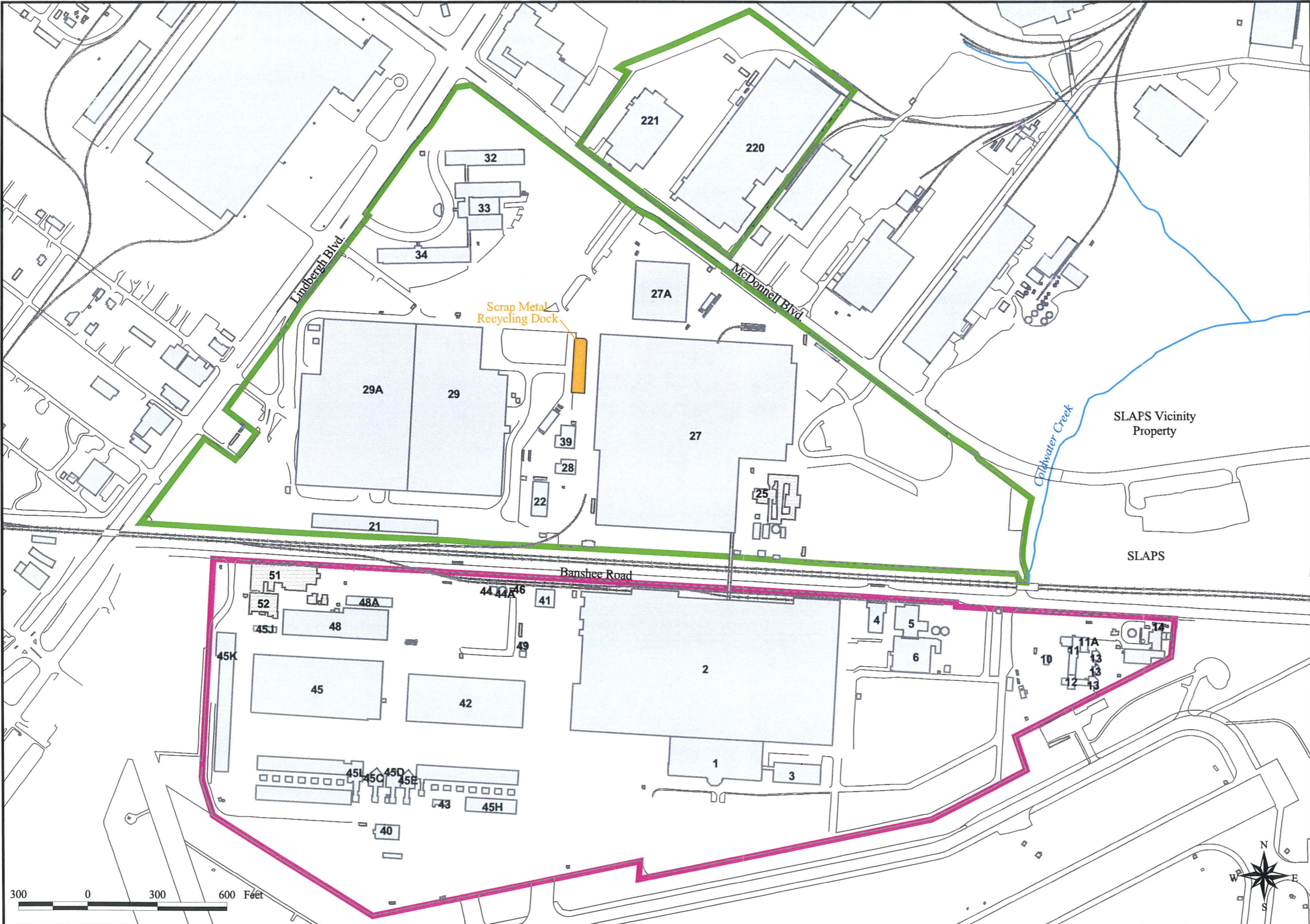
Drawn by: BSM Approved by:
Checked by: Date: February 3, 2004



Figure 2-1
Facility Map
Enhanced Bioremediation
Pilot Test
Boeing Tract 1,
Hazelwood, Missouri

Legend

- Existing Building
- Demolished Building
- Boeing Tract 1 North
- Boeing Tract 1 South



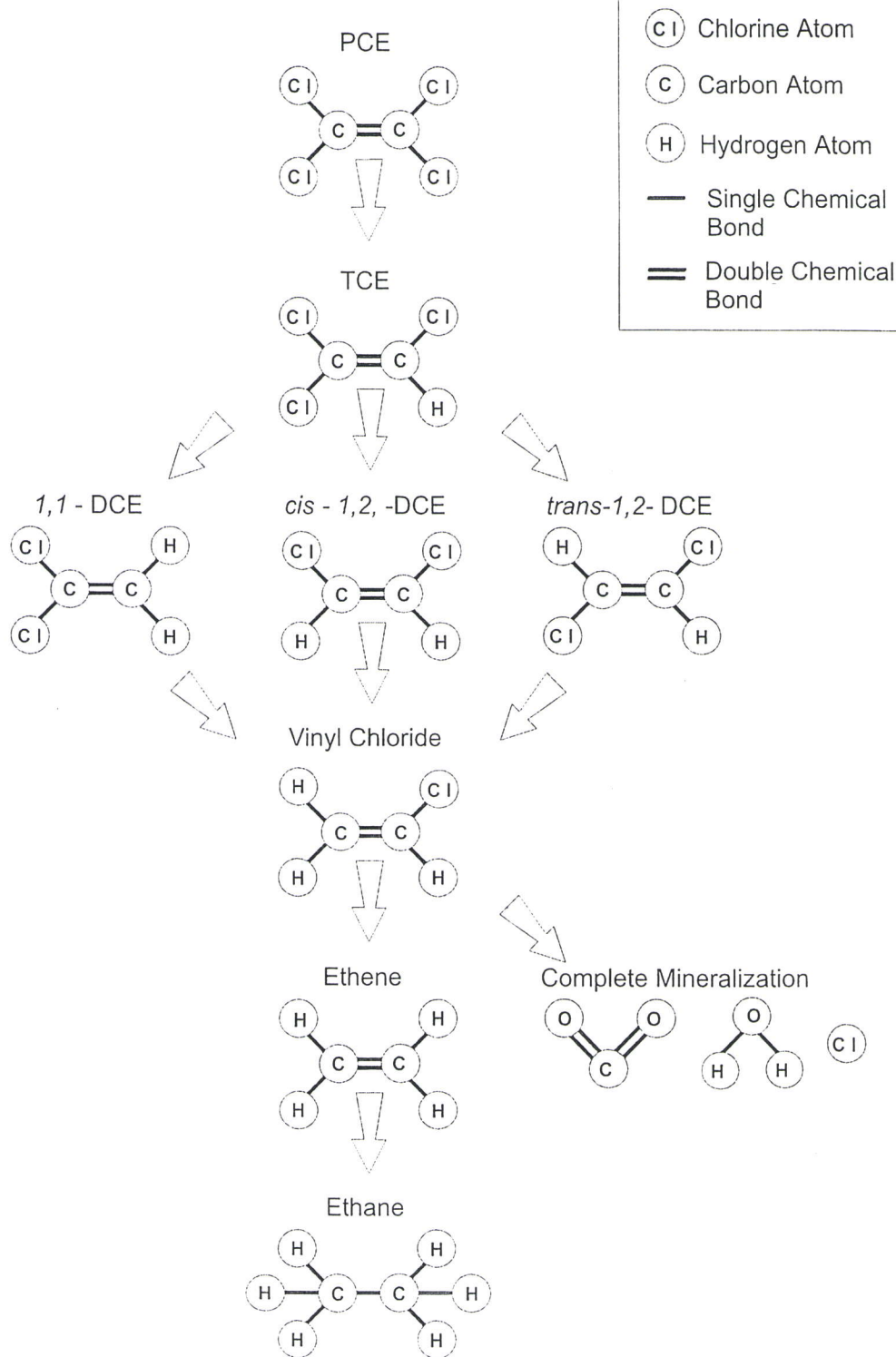
Scale

1:4800

1" = 300'

Drawn by: BSM Approved by:
Checked by: Date: February 3, 2004





Source: USEPA, 1998

Figure 3-1
Reduction Dehalogenation of Chlorinated
Ethenes
Enhanced Bioremediation Pilot Test
Boeing Tract 1
Hazelwood, Missouri

Drawn by: DLB
 Checked by: LMS
 Approved by:
 Date: 2/4/2004

 **MACTEC**

Well MW3
Target Volatile Organic Compound Analysis

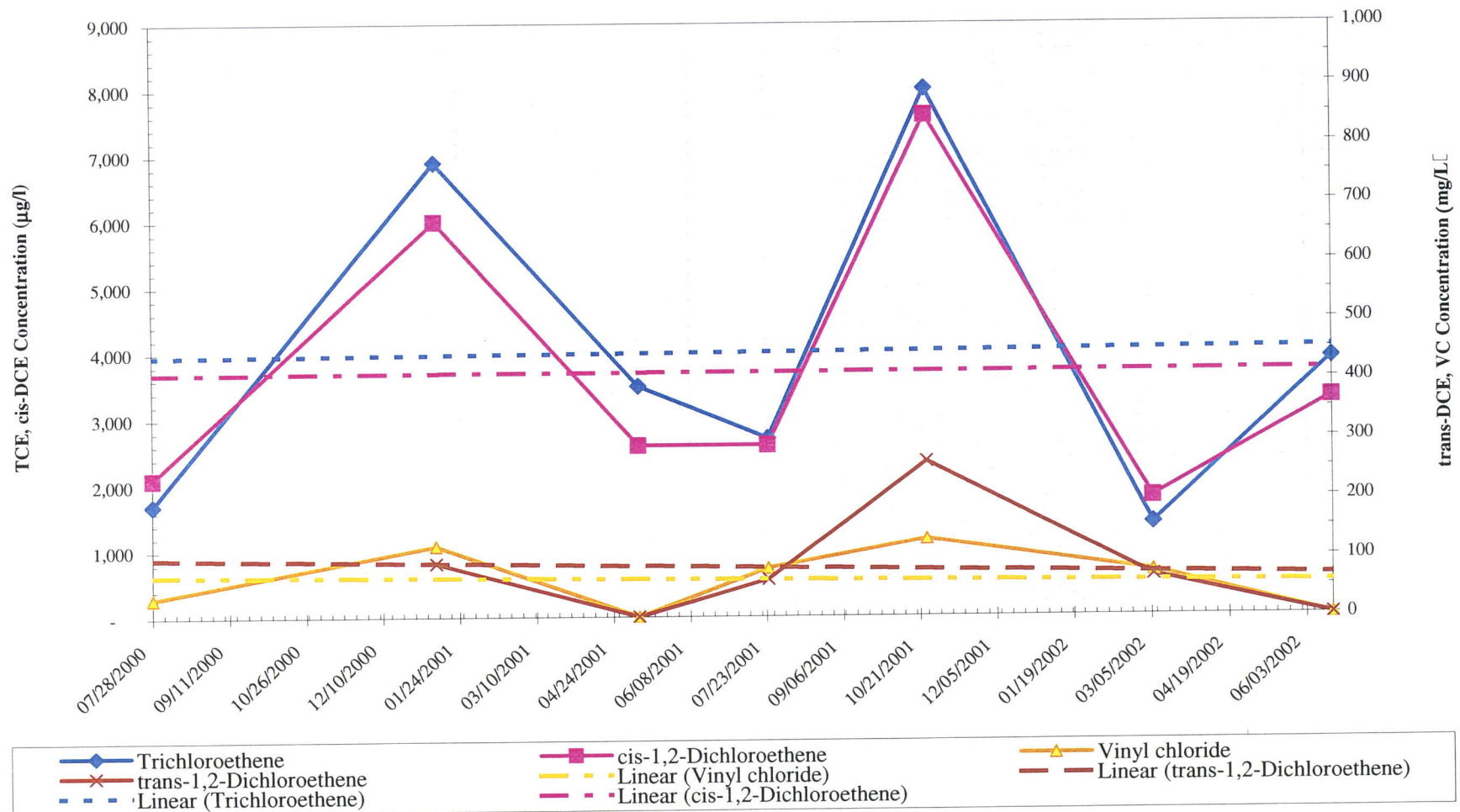


Figure 4-1 Summary of Pre-Pilot Test Target VOC Analysis from MW3
Enhanced Bioremediation Pilot Test
Boeing Tract 1
Hazelwood, Missouri

Drawn by: DLB
Checked by: LMS
Approved by:
Date: 2/4/2004



Figure 4-2
Pilot Test Site Map
Enhanced Bioremediation
Pilot Test,
Boeing Tract 1,
Hazelwood, Missouri

Legend

- Shallow Well
- Deep Well
- ⊗ Shallow Piezometer
- ▲ RFI Shallow Boring/
Temp. Piezometer
- Industrial Sewer Intake
- Industrial Sewer Manhole
- Water Line
- Industrial Sewer Line

Scale

1:840

1" = 150'

Drawn by: BSM

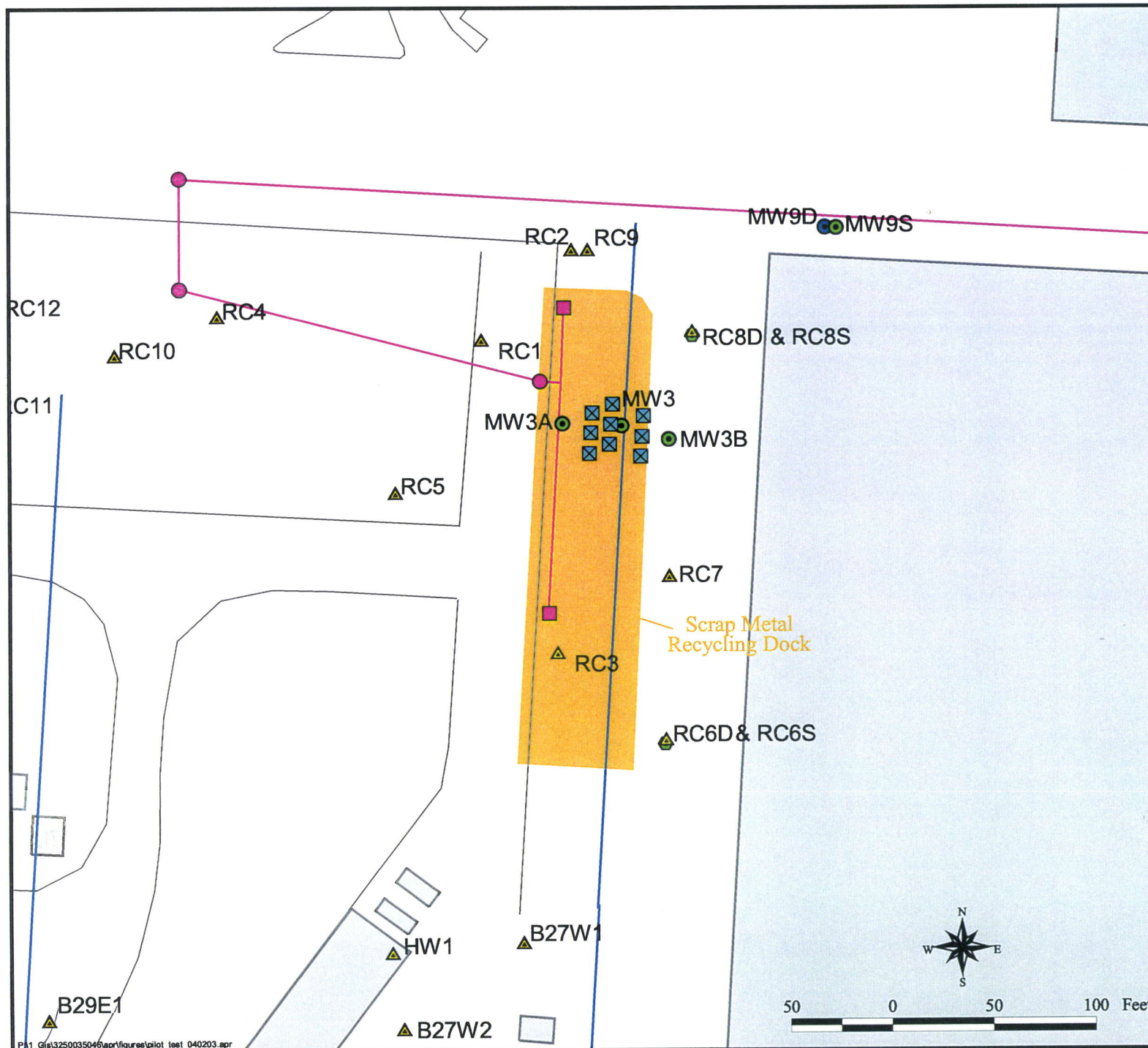
Approved by:

Checked by:

Date: February 3, 2004



MACTEC, Inc.



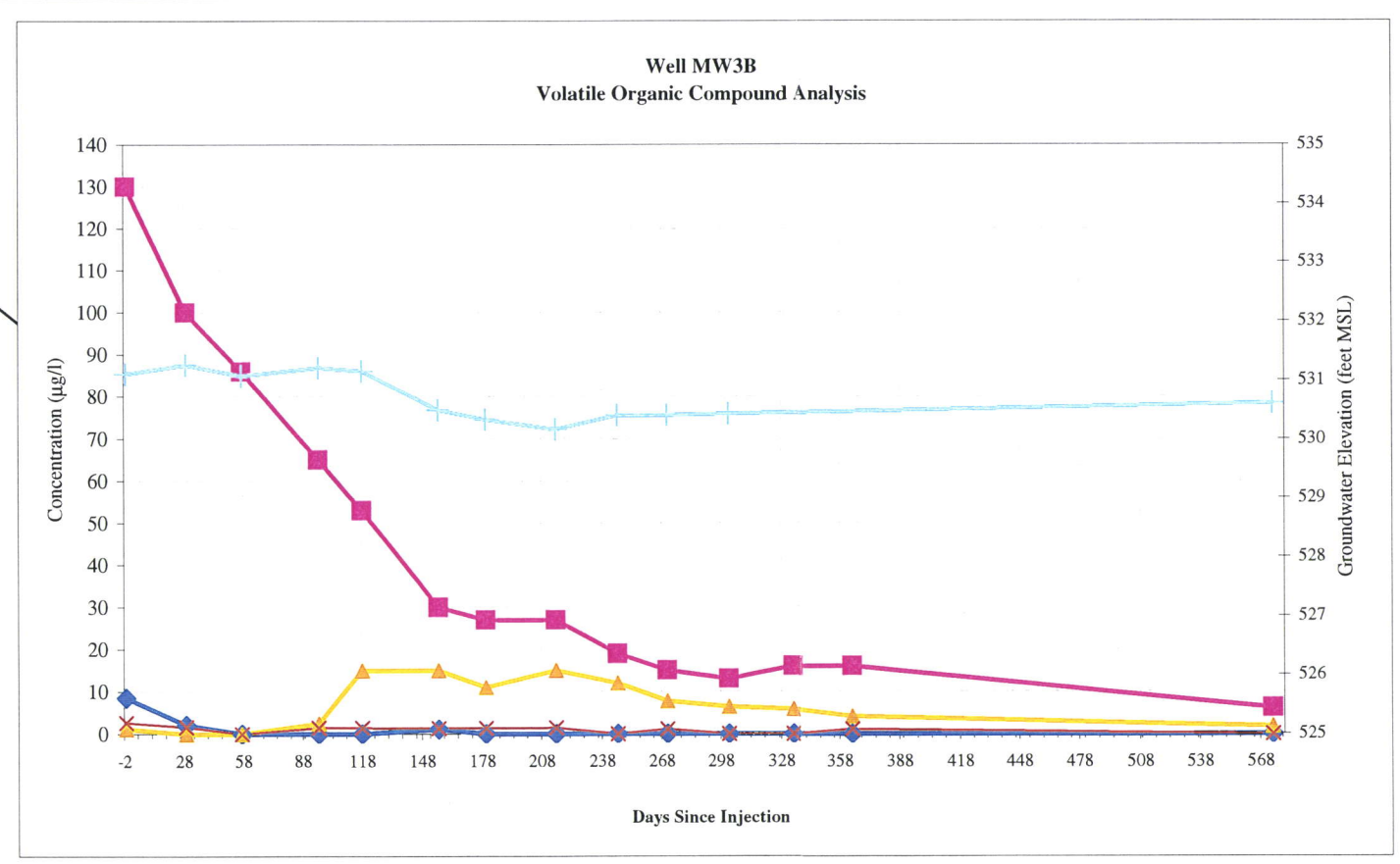
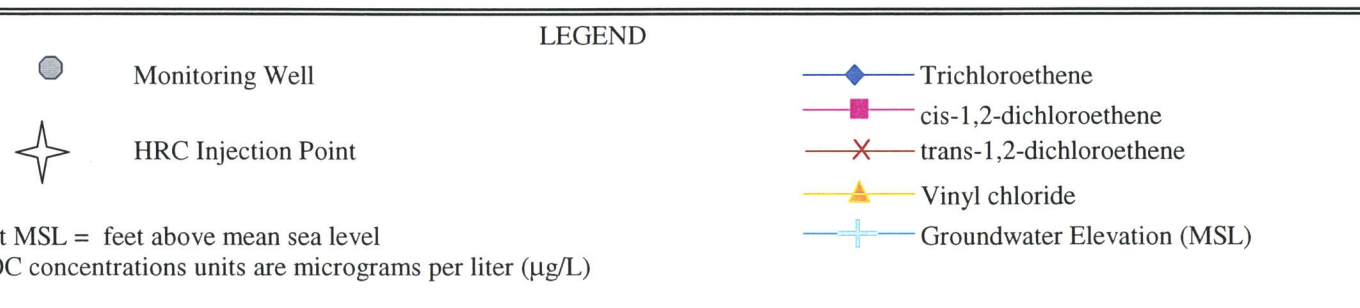
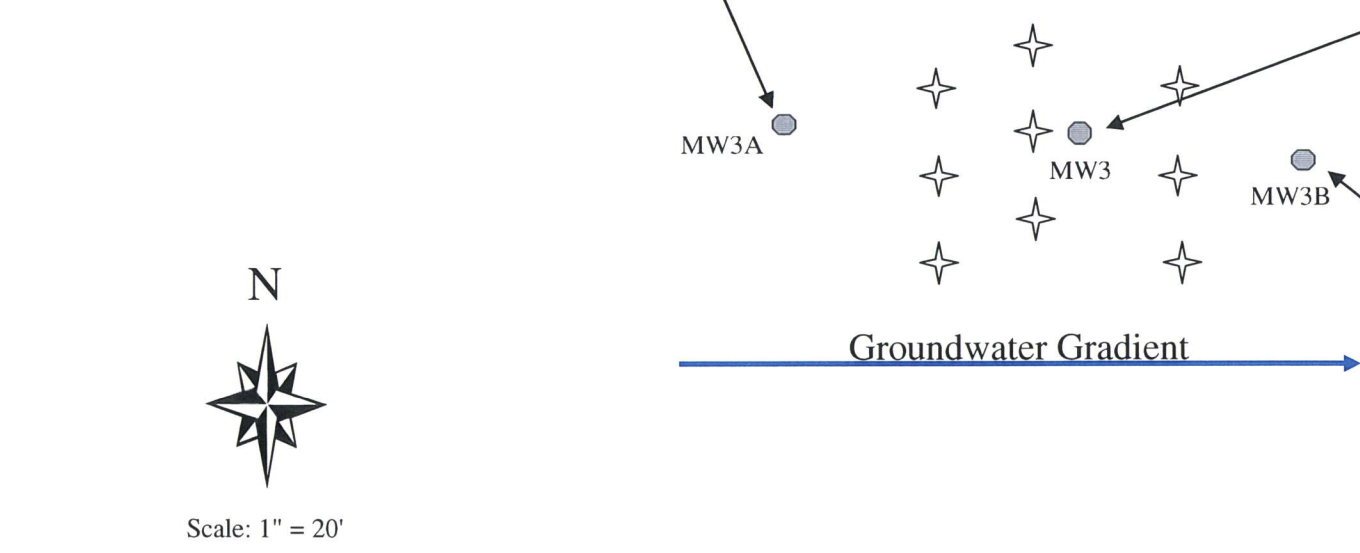
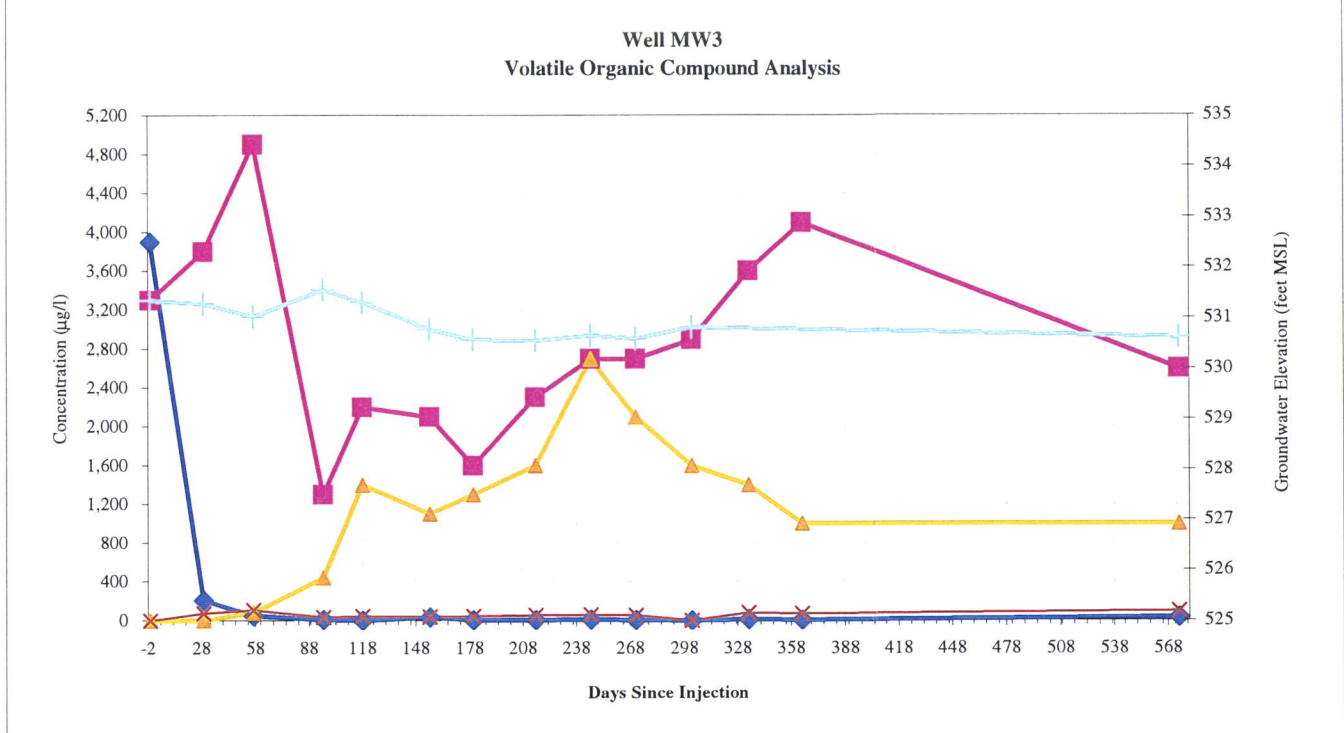
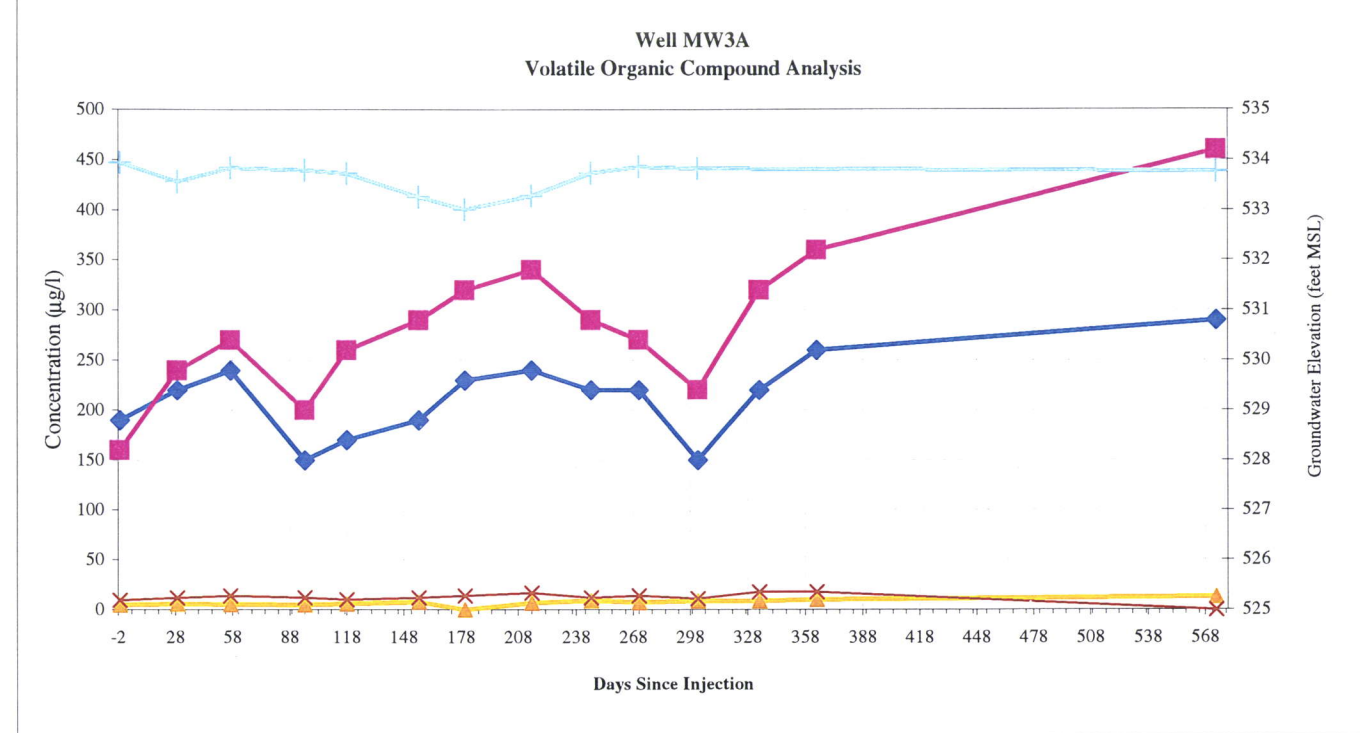


Figure 5-1 Summary of Target VOC Analysis Data
 Enhanced Bioremediation Pilot Test
 Boeing Tract 1
 Hazelwood, Missouri

Drawn by: DLB Approved by:
 Checked by: LMS Date: 02/03/2004



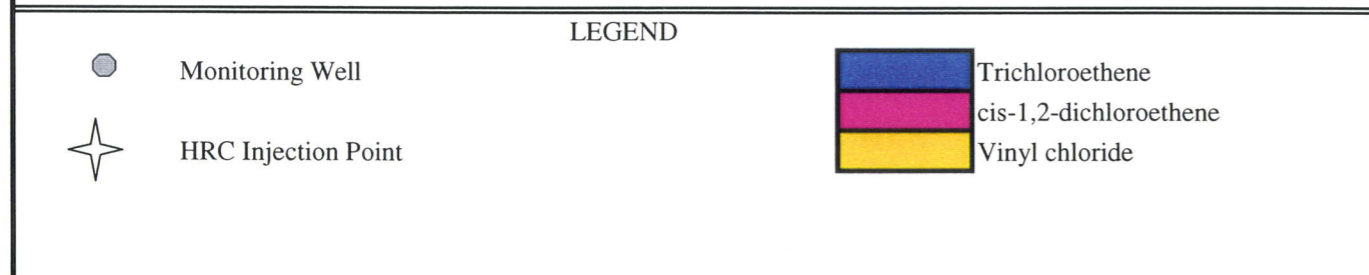
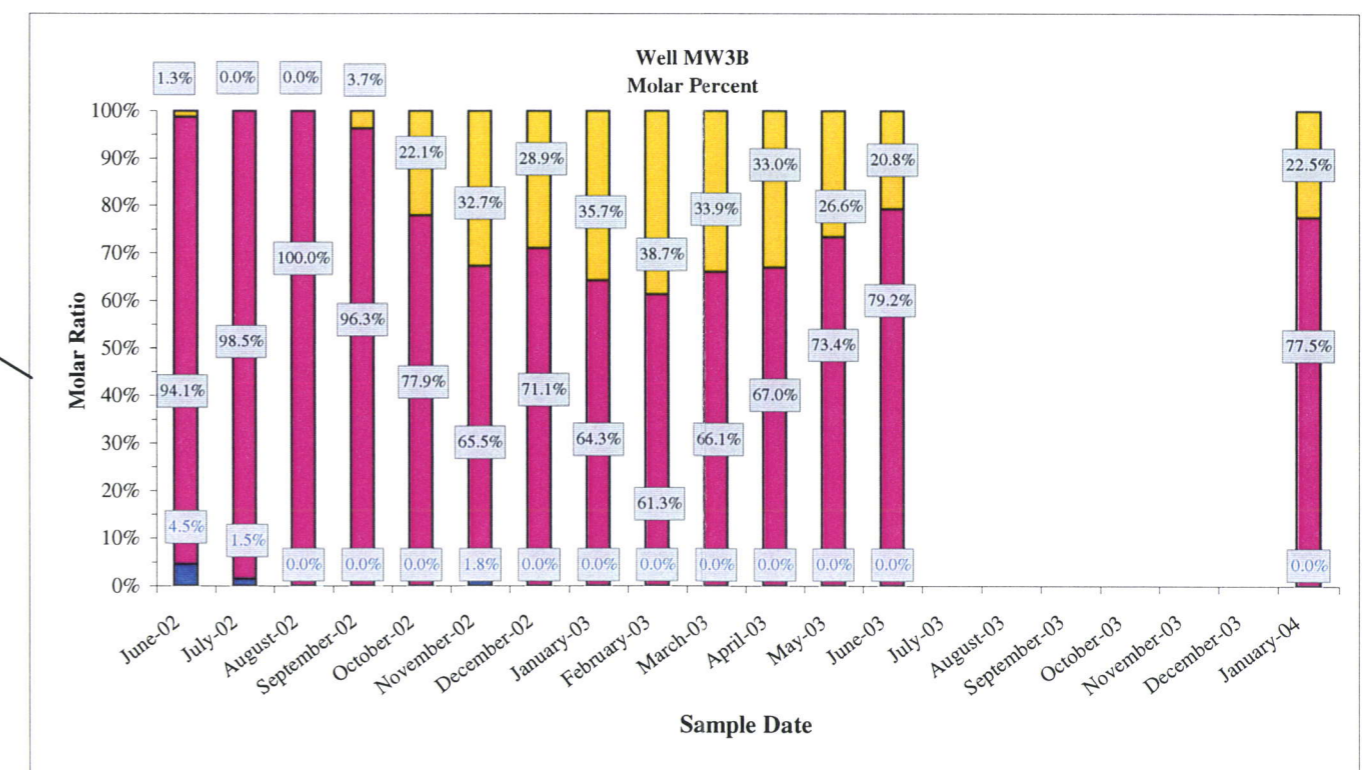
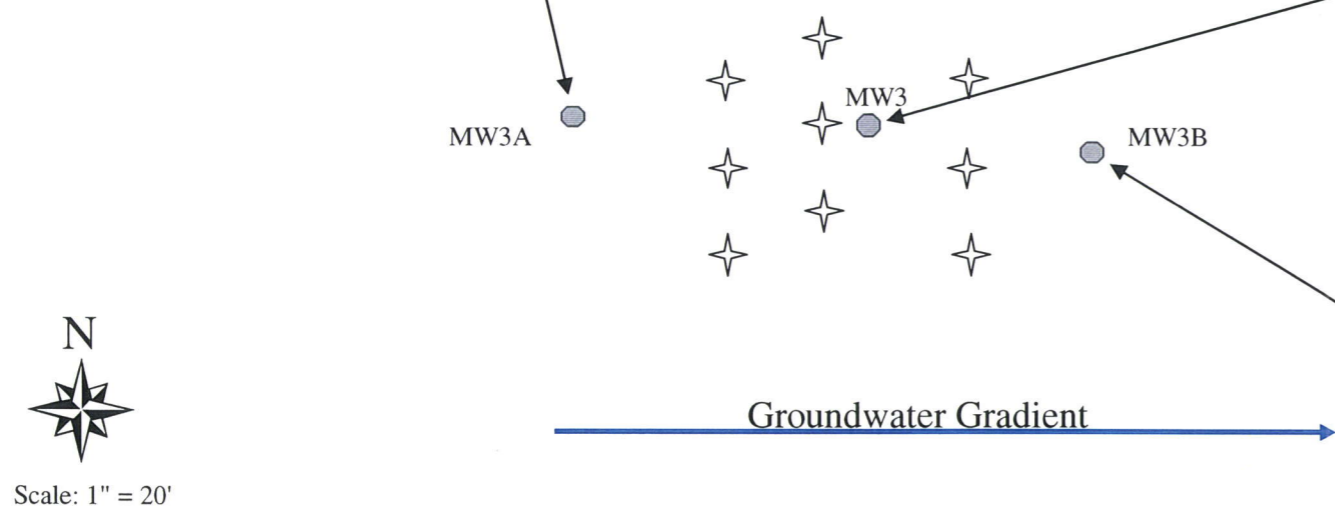
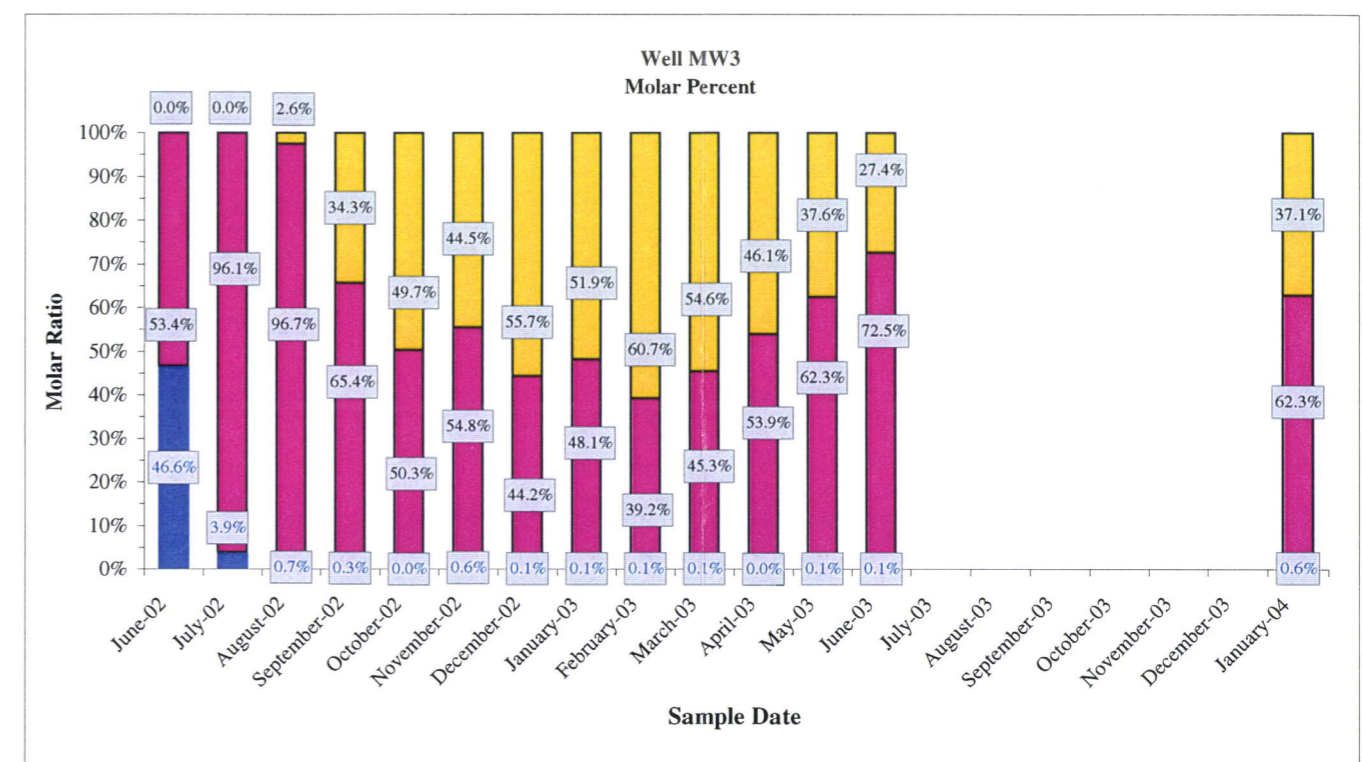
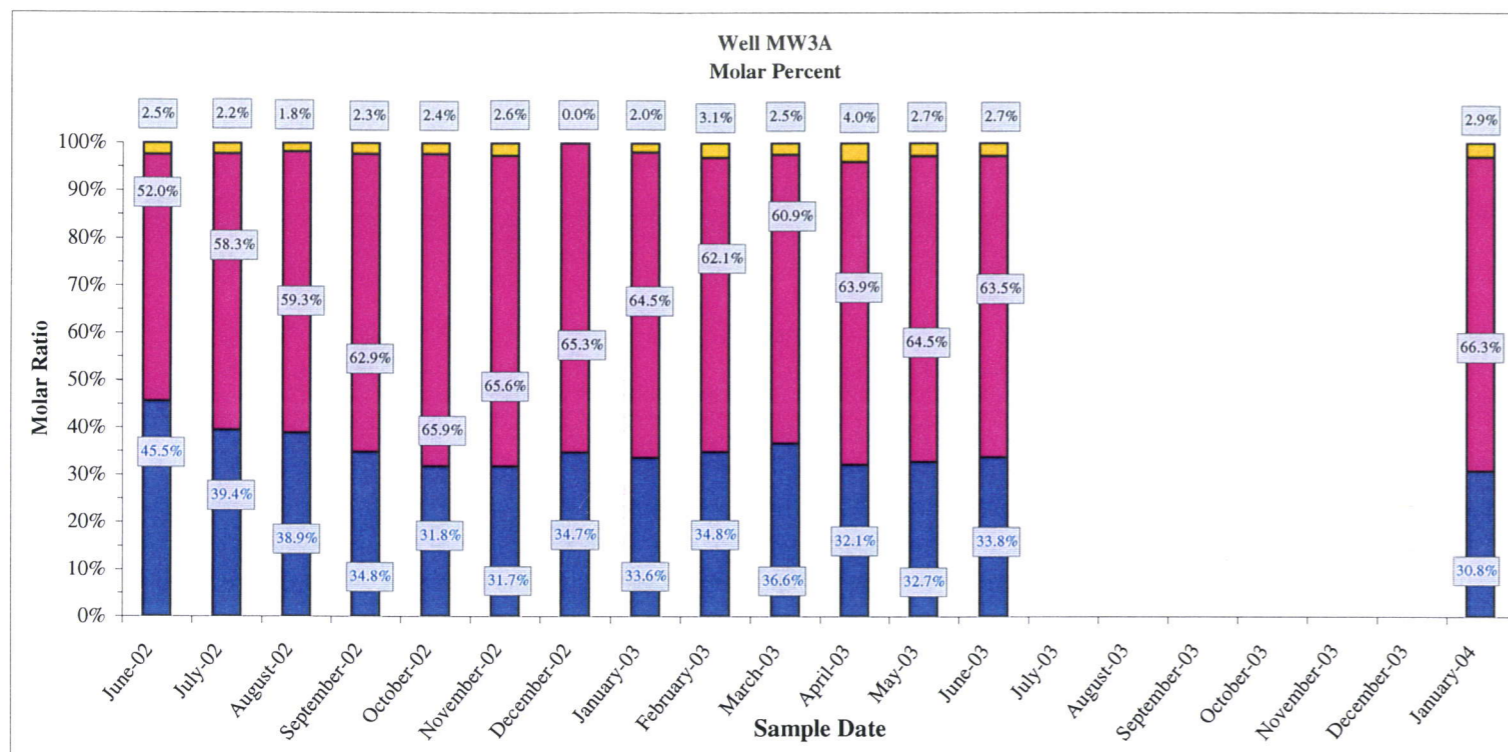
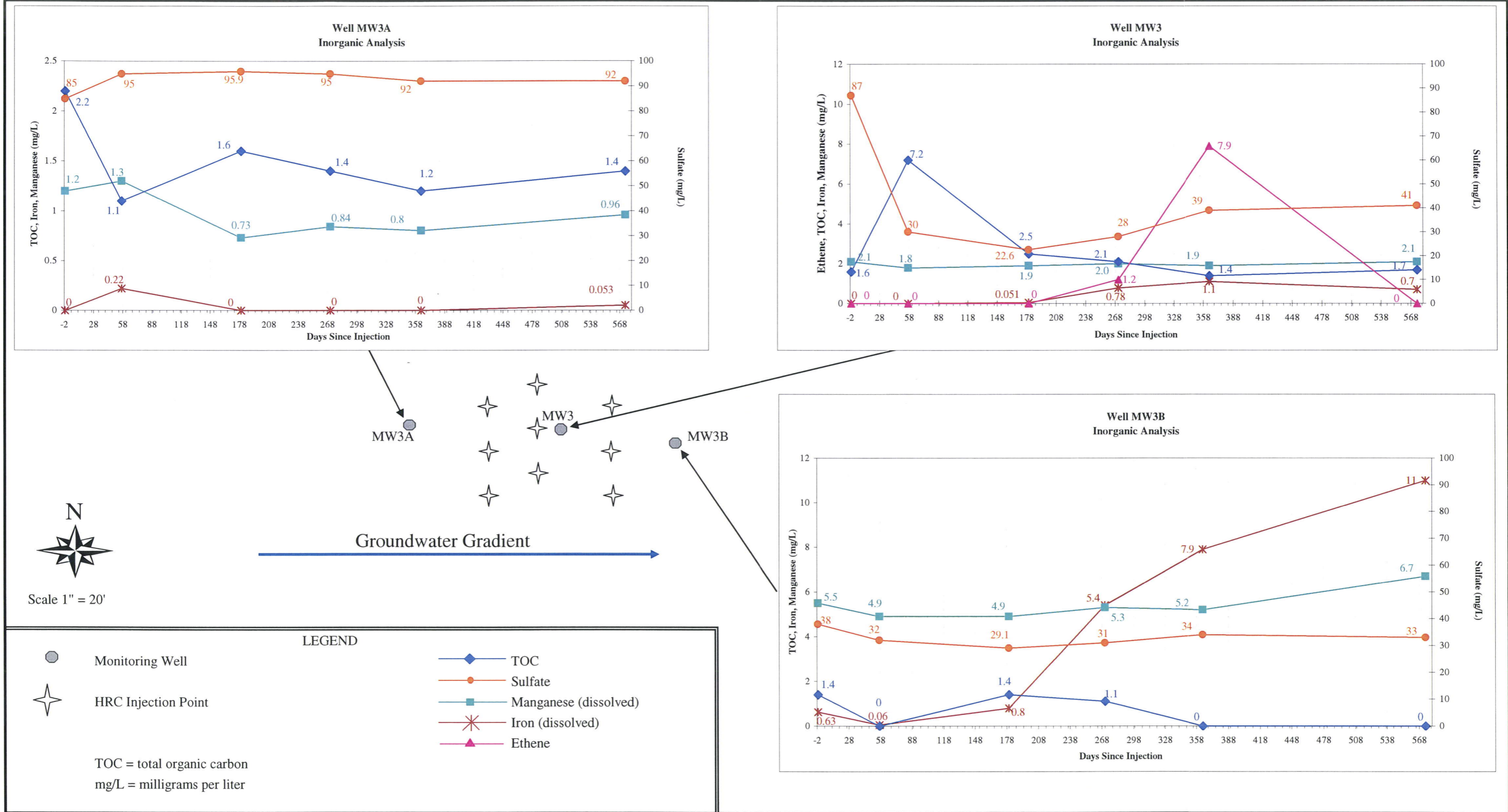


Figure 5-2 Summary of Target VOC Molar Percentage Data
Enhanced Bioremediation Pilot Test
Boeing Tract 1
Hazelwood, Missouri

Drawn by: DLB
Approved by:
Checked by: LMS
Date: 02/03/2004





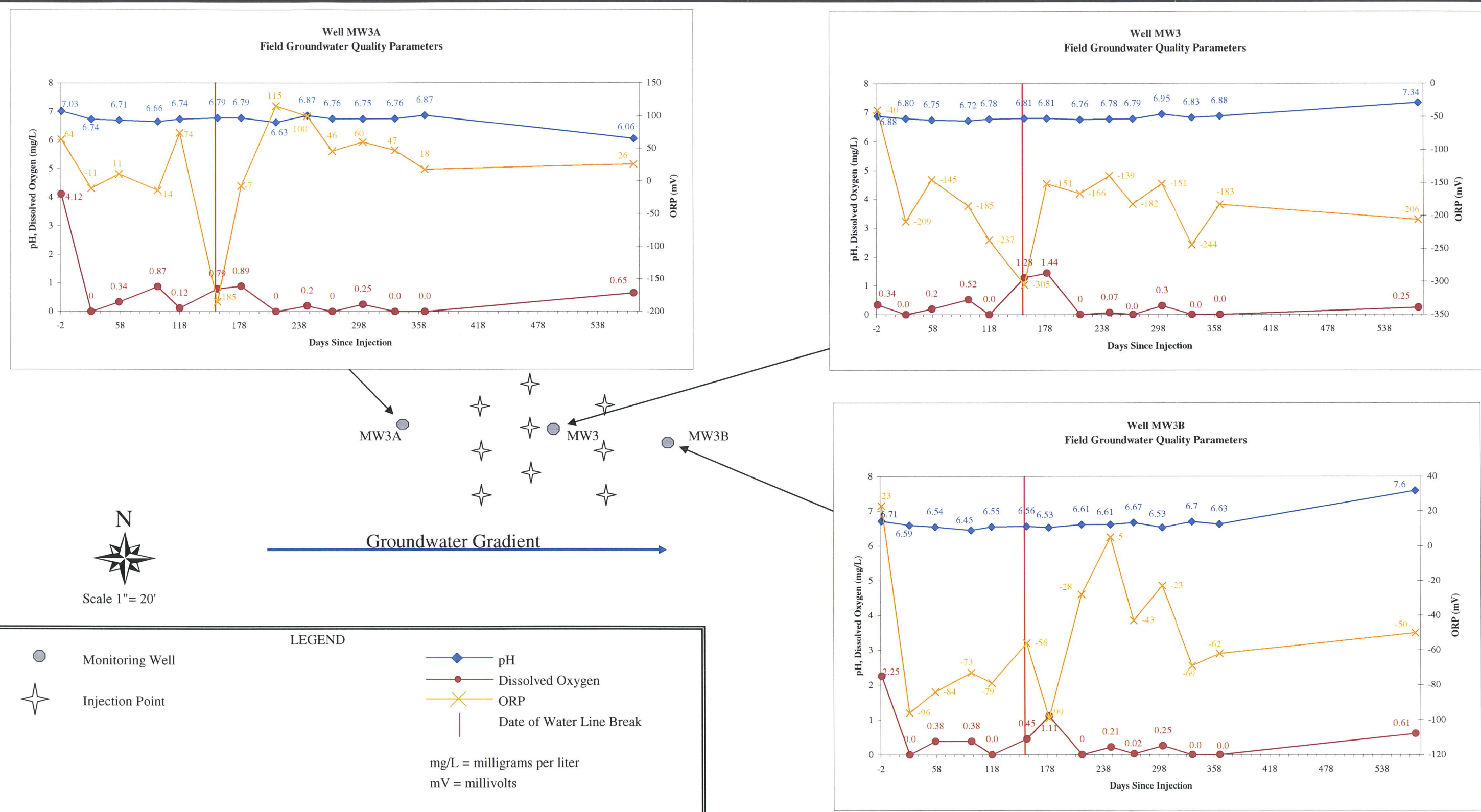


Figure 5-4 Summary of Field Parameter Data
Enhanced Bioremediation Pilot Test
Boeing Tract 1
Hazelwood, Missouri

Drawn by: DLB Approved by:
 Checked by: LMS Date: 02/03/2004



Appendix A

Boring and Monitoring Well Logs



Well Log

Client: Boeing

Location: Tract 1 North

Boring #
MW3

Logged By: D. Brinkley

Project #
510098

Field Location:



Drilled By: Roberts Environmental

Date:
07/19/2000

Drilling Method: Hollow Stem Auger

Sampling Method: 5' CME Continuous

Sheet:
1 of 1

Hole Diameter: 8.5 inch

Depth (ft)	Graphic Log	Sampler Location	Sample Recovery	Analyses/Tests		Time	USCS Symbol	Well Construction: 2" sch 40 PVC, 0.001" slot screen	
				PID (ppm)	Lab Sample ID			Screen Interval:	
								19.7	to 9.7
								19.7	to 7.5
								8 ft.	to 2 ft.
								Description: 2" asphalt, 8" concrete pavement. No rock base below concrete.	
				3	MW-3-2		cl	silty clay, moderate plasticity, grayish olive, soft, slightly moist, no odor	
			36"						
5						1505			
				3					
							cl	Silty clay, high plasticity, ducky yellowish brown, soft, some iron staining, no odor	
				2					
			36"						
10						1515			
				5					
							cl	Silty clay, grayish olive, moderate to high plasticity, moist, stiff, no odor	
				4					
			60"						
15						1530			
				5					
							cl	as above, very stiff, wet	
				2					
20			60"			1540			

Well Log

Client: Boeing

Location:	Tract 1 North
-----------	---------------

Boring #	MW3A
----------	------

Logged By:

D. Brinkley

Project #	510098
-----------	--------

Field Location:



Drilled By: Roberts Environmental

Date: 06/10/2003

Drilling Method: Hollow Stem Auger

Sampling Method: 5' CME Continuous

Sheet:
1 of 1

Hole Diameter:	8.5 inch
----------------	----------

Depth (ft)	Graphic Log	Sampler Location	Sample Recovery	Analyses/Tests		Time	USCS Symbol	Well Construction: 2" sch 40 PVC, 0.001" slot screen			
				PID (ppm)	Lab Sample ID			Screen Interval: 20 ft. to 5 ft.	Sand Pack: 20.5 ft. to 3 ft.	Seal: 3 ft. to 1 ft.	
						0840		Description: 8" concrete pavement			
				1			cl	Silty clay, moderate plasticity, grayish olive, soft, slightly moist, no odor, lots of iron staining and root scars			
			36"	5							
5				4				As above, becoming moist to wet, dusky yellowish brown, moderate to high plasticity, some iron staining, no odor			
				0		0855					
			48"	1			cl	Color change at 10' to grayish olive, moderate to high plasticity, three long root traces 8" long, vertical at 9' to 10', iron oxidized inside but open up to 0.25"			
10				2							
			60"	1		0905					
15								cl	Silty clay, grayish olive, moderate to high plasticity, stiff, moist to wet		
				1							
			60"			0910					
20			6"	1			as above				

Appendix B

Underground Injection Control Permit

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
MISSOURI CLEAN WATER COMMISSION



MISSOURI STATE OPERATING PERMIT

UNDERGROUND INJECTION CONTROL

Permit No. UI-0000020

Owner: Boeing Company
Address: PO Box 516, St. Louis, MO 63166

Continuing Authority: Same as above
Address: Same as above

Facility Name: Boeing Fabrication Facility (Former)
Facility Address: 142 J.S. McDonnell Blvd., Hazelwood, MO 63042

Legal Description: NW ¼, NW ¼, Sec. 5, T46N, R6E, St. Louis

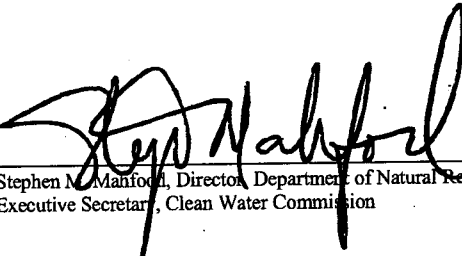
Receiving Stream: Unnamed Tributary to Coldwater Creek (U)
First Classified Stream and ID: Coldwater Creek (C) (01706)
USGS Basin & Sub-watershed No.: (10300200-180002)

FACILITY DESCRIPTION

Underground Injection - SIC #7389
Direct push borings to inject about 5,000 pounds of Hydrogen Release Compound, which is a lactic acid producing mixture, to a depth of about 30 feet to remediate chlorinated solvents that are present in the subsurface.

April 19, 2002
Effective Date

April 18, 2007
Expiration Date
MO 780-0041 (10-93)


Stephen M. Mahford, Director, Department of Natural Resources
Executive Secretary, Clean Water Commission

Interim Director of Staff, Clean Water Commission

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS					PAGE NUMBER 2 of 6	
					PERMIT NUMBER UI-0000020	
The permittee is authorized to discharge from outfall(s) with serial number(s) as specified in the application for this permit. The final effluent limitations shall become effective upon issuance and remain in effect until expiration of the permit. Such discharges shall be controlled, limited and monitored by the permittee as specified below:						
OUTFALL NUMBER AND EFFLUENT PARAMETER(S)	UNITS	FINAL EFFLUENT LIMITATIONS			MONITORING REQUIREMENTS	
		DAILY MAXIMUM	WEEKLY AVERAGE	MONTHLY AVERAGE	MEASUREMENT FREQUENCY	SAMPLE TYPE
<u>Preproject Monitoring</u>						
pH - Units	SU	**		**	once before project begins	grab
Trichloroethylene (TCE)	mg/L	*		*	once before project begins	grab
<u>Postproject Monitoring</u>						
pH - Units	SU	**		**	once after projects completed	grab
Trichloroethylene (TCE)	mg/L	*		*	once after projects completed	grab
Lactic Acid	mg/L	*			once after projects completed	grab
Total Pounds Chemical Injected	lbs				once after projects completed	report
MONITORING REPORTS SHALL BE SUBMITTED as outlined above; THE FIRST REPORT IS DUE as outlined above. THERE SHALL BE NO DISCHARGE OF FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.						
B. STANDARD CONDITIONS						
IN ADDITION TO SPECIFIED CONDITIONS STATED HEREIN, THIS PERMIT IS SUBJECT TO THE ATTACHED Part I STANDARD CONDITIONS DATED October 1, 1980, AND HEREBY INCORPORATED AS THOUGH FULLY SET FORTH HEREIN.						

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

- * Monitoring requirement only.
- ** pH is measured in pH units and is not to be averaged. The pH is limited to the range of 6.0-9.0 pH units.

C. SPECIAL CONDITIONS

1. This permit does not allow for the surface discharge of any water. If permittee desires to discharge water to the surface, an NPDES State Operating Permit must first be obtained.

STANDARD CONDITIONS FOR UNDERGROUND INJECTION CONTROL PERMIT

GENERAL CONDITIONS

SECTION A - MONITORING AND REPORTING

1. Representative Sampling

- a. Samples and measurements taken as required herein shall be representative of the nature and volume.
- b. Monitoring results shall be recorded and reported, postmarked no later than the 28th day of the month following the completed reporting period. Signed copies of these, and all other reports required herein, shall be submitted to the appropriate regional office and the Division of Geology and Land Survey, P.O. Box 250, Rolla, Missouri 65401.

2. Definitions

Definitions as set forth in the Missouri Clean Water Law and Missouri Clean Water Commission Definition Regulation 10 CSR 20-2.010 shall apply to terms used herein.

3. Test Procedures

Test procedures for the analysis of pollutants shall be in accordance with the Missouri Clean Water Commission Effluent Regulation 10 CSR 20-7.015.

4. Recording of Results

- a. For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:
 - i. The date, exact place, and time of sampling or measurements;
 - ii. The individual(s) who performed the sampling or measurements;
 - iii. The date(s) analyses were performed;
 - iv. The individual(s) who performed the analyses;
 - v. The analytical techniques or methods used; and
 - vi. The results of such analyses.
- b. The Federal Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than \$10,000 per violation, or by imprisonment for not more than 6 months per violation, or both.
- c. Calculations of all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Director in the permit.

5. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Monitoring Report Form. Such increased frequency shall also be indicated.

6. Records Retention

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application. This period may be extended by request of the Department at any time.

SECTION B - MANAGEMENT REQUIREMENTS

1. Noncompliance Notification

- a. If, for any reason, the permittee does not comply with or will be unable to comply with any daily maximum limitation specified in this permit, the permittee shall provide the Department with the following information, in writing within five (5) days of becoming aware of such condition:
 - i. A description of the violation and cause of noncompliance, and
 - ii. The period of noncompliance, including exact dates and times or, if not corrected, that anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the noncompliance.
- b. Twenty-four hour reporting. The permittee shall report any noncompliance, which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The Department may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

2. Facilities Operation

Permittees shall operate and maintain facilities to comply with the Missouri Clean Water Law and applicable permit conditions.

3. Adverse Impact

The permittee shall take all necessary steps to minimize any adverse impact to waters of the state resulting from noncompliance with any limitations specified in this permit or set forth in the Missouri Clean Water Law and Regulations (hereinafter the Law and Regulations), including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

4. Removed Substances

Solids, sludge, filter backwash, or other pollutants removed in the course of treatment or control of waters shall be disposed of in a manner such as to prevent any pollutants from entering waters of the state unless permitted by the Law, and a permanent record of the date and time, volume and methods of removal and disposal of such substances shall be maintained by the permittee.

5. Right of Entry

For the purpose of inspecting, monitoring, or sampling the injection wells, point source, water contaminant source, or wastewater treatment facility for compliance with the Clean Water Law and these regulations, authorized representatives of the Department shall be allowed by the permittee, upon presentation of credentials and at reasonable times:

- a. to enter upon permittee's premises in which an injection well, point source, water contaminant source, or wastewater treatment facility is located or in which any records are required to be kept under terms and conditions of the permit;
- b. to have access to, or copy any records required to be kept under terms and conditions of the permit;
- c. to inspect any monitoring equipment or method required in the permit;
- d. to inspect any collection, treatment, or discharge facility covered under the permit; and
- e. to sample any wastewater at any point in the collection system or treatment process.

SECTION B - MANAGEMENT REQUIREMENTS (continued)

6. Permits Transferable

- a. Subject to section (3) of 10 CSR 20-6.010 an operating permit may be transferred upon submission to the Department of an application to transfer signed by a new owner. Until such time as the permit is officially transferred, the original permittee remains responsible for complying with the terms and conditions of the existing permit.
- b. The Department, within thirty (30) days of receipt of the application shall notify the new permittee of its intent to revoke and reissue or transfer the permit.

7. Availability of Reports

Except for data determined to be confidential under the Missouri Clean Water Commission Regulation for Public Participation, Hearings and Notice to Governmental Agencies 10 CSR 20-6.020, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department. As required by statute, operating data shall be subject to the imposition of criminal penalties as provided for in Section 644.076 of the Law.

8. Permit Modifications

- a. Subject to compliance with statutory requirements of the Law and Regulations and applicable Court Order, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:
 - i. violation of any terms or conditions of this permit or the Law;
 - ii. having obtained this permit by misrepresentation or failure to disclose fully all relevant facts;
 - iii. a change in any circumstances or conditions that requires either a temporary or permanent reduction or elimination of the authorized discharge, or
 - iv. any reason set forth in the Law and Regulations.

9. Civil and Criminal Liability

Except as authorized by statute nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

10. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state statute or regulations.

11. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of or violation of federal, state or local laws or regulations.

12. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for a new permit 180 days prior to expiration of this permit.

SECTION B - MANAGEMENT REQUIREMENTS (continued)

13. Signatory Requirement

All reports or information submitted to the Director shall be signed.

14. Rights Not Affected

Nothing in this permit shall affect the permittee's right to appeal or seek a variance from applicable laws or regulations as allowed by law.

15. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

Appendix C

Analytical Laboratory Reports and Chain-of-Custody Forms

ANALYTICAL REPORT

November 19, 2001

Page 1 of 1

Work Order: 11J1098

Report To

Doug Marian
Harding ESE
3199 River Port Tech Center
St. Louis, MO 63043

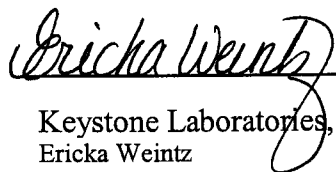
Work Order Information

Date Received: 10/26/2001 11:05AM
Collector:
Collector Phone: 314-567-4600
PO Number:

Project: Boeing/GKN
Project Number: Boeing

Analyte	Result	MRL	Method	Analyst	Analyzed	Qualifier
11J1098-01	MW3W		Matrix: Water		Collected: 10/25/01 15:55	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	FIZ	11/16/01 9:47	

End of Report



Keystone Laboratories, Inc.
Ericka Weintz
Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.



11665 Lilburn Park Road, St. Louis, MO 63146-3535
Telephone: (314) 567-4600 -- Fax: (314) 567-5030

FOR LAB USE ONLY

Project Number:

1151098 0078

Chain of Custody Record

Client: HARDING ES
Address: 3199 RIVERPORT TECH CENTER
ST LOUIS MO 63043

Phone #: (314) 209-5900 Fax #: (314) 209-5929

P.O. #: _____

Client Contact: Doree MARION

Project # / Location: BOENG/GKN

Sample Type: **Container Type:**

1. Water P - Plastic
2. Soil G - Glass
3. Sludge V - VOC
4. Oil
5. Tissue
Other :

Preservative:

1. None
2. H_2SO_4
3. HNO_3
4. NaOH
5. HCl

Analyses

[illegible]

Relinquished By:

Date: 10-25-01
Time: 17:25

Received By:

Date: -- --

Time: _____

Relinquished By:

Date: -- --
Time: :

Received For Lab By:

Date: 10-26 --01

Time: 11:05

FOR LAB USE ONLY

Samples Received Chilled

☐ Yes ☐ No

SPECIAL INSTRUCTIONS: *Preserve ASAT*

Copies: White - Client Canary - Lab Receiving Pink - Lab File Goldenrod - Retained by Sampler

Accreditations:
Iowa DNR: 095
New Jersey DEP: IA001
Kansas DHE: E-10287

ANALYTICAL REPORT

September 25, 2002

Page 1 of 2

Work Order: 12F0702

Report To

Dennis Brinkley
Harding ESE - MO
3199 River Port Tech Center
St. Louis, MO 63043

Work Order Information

Date Received: 06/20/2002 10:00AM
Collector: Friesner, Jack
Phone: 314-567-4600
PO Number:

Project: Boeing/GKN
Project Number: Boeing

Analyte	Result	MRL	Method	Analyst	Analyzed	Qualifier
12F0702-01	MW3W		Matrix: Water		Collected: 06/19/02 08:30	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	HPLC/UV	JLH	06/26/02 23:24	
Lactic Acid (C3)	26.6 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:24	
Lactic Acid (C3)	26.6 mg/l	1.0	HPLC/UV	GGD	06/26/02 23:24	
Acetic Acid (C2)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:24	
Propionic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:24	
Butyric Acid (C4)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:24	
12F0702-02	MW3AW		Matrix: Water		Collected: 06/19/02 17:45	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	HPLC/UV	JLH	06/26/02 23:45	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:45	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	GGD	06/26/02 23:45	
Acetic Acid (C2)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:45	
Propionic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:45	
Butyric Acid (C4)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:45	
12F0702-03	MW3BW		Matrix: Water		Collected: 06/19/02 15:00	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	HPLC/UV	JLH	06/27/02 0:06	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	GGD	06/27/02 0:06	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/27/02 0:06	
Acetic Acid (C2)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/27/02 0:06	
Propionic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/27/02 0:06	
Butyric Acid (C4)	<1.0 mg/l	1.0	HPLC/UV	JLH	06/27/02 0:06	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL = Method Reporting Limit.

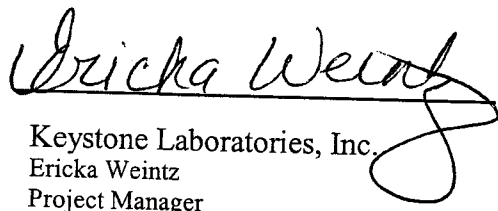
Harding ESE - MO
3199 River Port Tech Center
St. Louis, MO 63043

Work Order: 12F0702

September 25, 2002

Page 2 of 2

End of Report



Keystone Laboratories, Inc.
Ericka Weintz
Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL = Method Reporting Limit.

Keystone
LABORATORIES, INC.

~~600 E. 17th St. S.~~
~~Newton, IA 50208~~
~~Phone: 641-792-8451~~
~~Fax: 641-792-7989~~

☐ 3012 Ansborough Ave.
Waterloo, IA 50701
Phone: 319-235-4440
Fax: 319-235-2480

 1304 Adams
Kansas City, KS 66103
Phone: 913-321-7856
Fax: 913-321-7937

PAGE ____ OF ____

PRINT OR TYPE INFORMATION BELOW

SAMPLER: JACK E FRIESNER

SITE NAME: BOEING/GGKN

ADDRESS:

CITY/ST/ZIP: ST LOUIS MO

PHONE:

REPORT TO:

NAME: DENNIS BRINKLEY

COMPANY NAME: HARDING ESE

ADDRESS: 3199 Riverport Tech Center Dr.

CITY/ST/ZIP: MARYLAND HEIGHTS, MO 63114

PHONE: (314) 209-5900

FAX: (314) 209-5927

BILL TO:

NAME:

COMPANY NAME: HARDING ESE

ADDRESS:

CITY/ST/ZIP:

PHONE:

Keystone Quote No.:

(If Applicable)

[illegible]

Relinquished by: (Signature)

Date 6/19/02

Time 1730

Received by: (Signature)

Date _____

Time

Turn-Around:

 Standard

 Rush

Contact Lab Prior to Submission

Relinquished by: (Signature)

Date

Time

Received for Lab by: (Signature)

Date

Time

Remarks:

Original - Return with Report • Yellow - Lab Copy • Pink - Sampler Copy

FORM: CCR 7-97

Accreditations:
Iowa DNR: 095
New Jersey DEP: IA001
Kansas DHE: E-10287

ANALYTICAL REPORT

October 10, 2002

Work Order: 12I0812

Page 1 of 3

Report To	Work Order Information
Dennis Brinkley Harding ESE - MO 3199 River Port Tech Center St. Louis, MO 63043	Date Received: 09/24/2002 10:40AM Collector: Phone: 314-567-4600 PO Number:

Project : Boeing/GKN

Project Number: Boeing

Analyte	Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
12I0812-01 MW3A				Matrix: Water		Collected: 09/23/02 07:15	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1J20820	HPLC/UV	JLH	10/07/02 20:19	
Lactic Acid (C3)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:19	
Acetic Acid (C2)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:19	
Propionic Acid (C3)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:19	
Butyric Acid (C4)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:19	
12I0812-02 MW3				Matrix: Water		Collected: 09/23/02 08:20	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1J20820	HPLC/UV	JLH	10/07/02 20:47	
Lactic Acid (C3)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:47	
Acetic Acid (C2)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:47	
Propionic Acid (C3)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:47	
Butyric Acid (C4)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:47	
12I0812-03 MW3B				Matrix: Water		Collected: 09/19/02 14:40	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1J20820	HPLC/UV	JLH	10/07/02 21:15	
Lactic Acid (C3)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 21:15	
Acetic Acid (C2)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 21:15	
Propionic Acid (C3)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 21:15	
Butyric Acid (C4)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 21:15	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.

Harding ESE - MO
3199 River Port Tech Center
St. Louis, MO 63043

October 10, 2002

Work Order: 12I0812

Page 2 of 3

Determination of Metabolic Acids - Quality Control

Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1J20820 - General Prep HPLC/IC										
Blank (1J20820-BLK1)				Prepared & Analyzed: 10/07/02						
Pyruvic Acid (C3)	ND	0.1	mg/l							
Lactic Acid (C3)	ND	1.0	"							
Acetic Acid (C2)	ND	1.0	"							
Propionic Acid (C3)	ND	1.0	"							
Butyric Acid (C4)	ND	1.0	"							
LCS (1J20820-BS1)				Prepared & Analyzed: 10/07/02						
Pyruvic Acid (C3)	55.00	0.1	mg/l	56.70		97.0	66-134			
Lactic Acid (C3)	237.3	1.0	"	198.9		119	68-138			
Acetic Acid (C2)	149.7	1.0	"	150.8		99.3	73-122			
Propionic Acid (C3)	156.7	1.0	"	156.0		100	77-120			
Butyric Acid (C4)	146.7	1.0	"	146.4		100	75-119			
Matrix Spike (1J20820-MS1)				Source: 12I0814-01		Prepared & Analyzed: 10/07/02				
Pyruvic Acid (C3)	46.34	0.1	mg/l	37.80	ND	123	58-127			
Lactic Acid (C3)	182.5	1.0	"	132.6	ND	138	58-132			QM-05
Acetic Acid (C2)	117.3	1.0	"	100.6	ND	117	65-128			
Propionic Acid (C3)	133.3	1.0	"	104.0	ND	128	64-128			
Butyric Acid (C4)	108.6	1.0	"	97.60	ND	111	67-127			
Matrix Spike Dup (1J20820-MSD1)				Source: 12I0814-01		Prepared & Analyzed: 10/07/02				
Pyruvic Acid (C3)	45.87	0.1	mg/l	37.80	ND	121	58-127	1.02	28	
Lactic Acid (C3)	185.9	1.0	"	132.6	ND	140	58-132	1.85	29	QM-05
Acetic Acid (C2)	120.5	1.0	"	100.6	ND	120	65-128	2.69	31	
Propionic Acid (C3)	134.6	1.0	"	104.0	ND	129	64-128	0.971	28	QM-05
Butyric Acid (C4)	113.2	1.0	"	97.60	ND	116	67-127	4.15	26	

ND = Non Detect; REC= Recovery; RPD= Relative Percent Difference

Notes and Definitions

QM-05 The spike recovery was outside acceptance limits for the MS and/or MSD due to matrix interference. The LCS and/or LCSD were within acceptance limits showing that the laboratory is in control and the data is acceptable.

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.

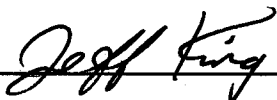
Harding ESE - MO
3199 River Port Tech Center
St. Louis, MO 63043

October 10, 2002

Work Order: 12I0812

Page 3 of 3

End of Report



Keystone Laboratories, Inc.
Ericka Weintz
Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL = Method Reporting Limit.



~~11665 Lilburn Park Road, St. Louis, MO 63146 3535~~
~~Telephone: (314) 567 4600 Fax: (314) 567 5030~~

FOR LAB USE ONLY

Project Number:

1218812

0099

Chain of Custody Record

Client: HARDING ESE
Address: 3199 RIVERPORT TECH CENTER DR.
ST. LOUIS MO 63043

Phone #: (314) 209-5900 Fax #: (314) 209-5927

P.O. #: _____

Client Contact: DENNIS BRINKLEY 1591

Project # / Location: BOEING / GKN

Sample Type: **Container Type:**

1. Water P - Plastic
2. Soil G - Glass
3. Sludge V - VOC
4. Oil
5. Tissue
Other :

Preservative:

1. None 4. NaOH
2. H₂SO₄ 5. HCl
3. HNO₃ 6. Phosphoric

Analyses

METABOLIC ACIDOSIS

Hy

pH
Specific Conductivity
Temperature

Comments

[illegible]

Relinquished By:

Date: 9-23 --02

Time: 10 00

Received By:

Date: -- --

Time: :

Relinquished By:

Date: 9-23-02

Time: 17:25:

Received For Lab By:

Date: 9-24-02

Time: 10:40

FOR LAB USE ONLY

Samples Received Chilled

☐ Yes ☐ No

SPECIAL INSTRUCTIONS:

Copies: White - Client Canary - Lab Receiving Pink - Lab File Goldenrod - Retained by Sampler

Accreditations:
Iowa DNR: 095
New Jersey DEP: IA001
Kansas DHE: E-10287

ANALYTICAL REPORT

January 08, 2003

Work Order: 12L0584

Page 1 of 1

Report To
Dennis Brinkley MACTEC (Harding ESE) 3199 River Port Tech Center St. Louis, MO 63043

Work Order Information
Date Received: 12/17/2002 10:04AM Collector: Friesner, Jack Phone: 314-567-4600 PO Number:

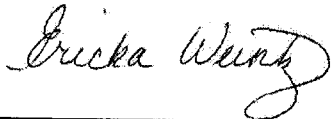
Project: Boeing/GKN
Project Number: Boeing/GKN

Analyte	Result	MRL	Method	Analyst	Analyzed	Qualifier
12L0584-01	MW3BW		Matrix: Water		Collected: 12/16/02 13:55	
Pyruvic Acid (C3)	<0.2 mg/l	0.2	HPLC/UV	JLH	01/07/03 10:20	R-01
Lactic Acid (C3)	<2.0 mg/l	2.0	HPLC/UV	JLH	01/07/03 10:20	R-01
Acetic Acid (C2)	<2.0 mg/l	2.0	HPLC/UV	JLH	01/07/03 10:20	R-01
Propionic Acid (C3)	<2.0 mg/l	2.0	HPLC/UV	JLH	01/07/03 10:20	R-01
Butyric Acid (C4)	<2.0 mg/l	2.0	HPLC/UV	JLH	01/07/03 10:20	R-01
12L0584-02	MW3W		Matrix: Water		Collected: 12/16/02 15:05	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	HPLC/UV	JLH	01/06/03 15:12	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	01/06/03 15:12	
Acetic Acid (C2)	<1.0 mg/l	1.0	HPLC/UV	JLH	01/06/03 15:12	
Propionic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	01/06/03 15:12	
Butyric Acid (C4)	<1.0 mg/l	1.0	HPLC/UV	JLH	01/06/03 15:12	
12L0584-03	MW3AW		Matrix: Water		Collected: 12/16/02 16:35	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	HPLC/UV	JLH	01/06/03 15:34	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	01/06/03 15:34	
Acetic Acid (C2)	<1.0 mg/l	1.0	HPLC/UV	JLH	01/06/03 15:34	
Propionic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	01/06/03 15:34	
Butyric Acid (C4)	<1.0 mg/l	1.0	HPLC/UV	JLH	01/06/03 15:34	

Notes and Definitions

R-01 The Reporting Limit for this analyte has been raised to account for matrix interference.

End of Report




Keystone Laboratories, Inc.

Ericka Weintz
Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL = Method Reporting Limit.

Keystone
LABORATORIES, INC.

~~NO~~ 600 E. 17th St. S.
Newton, IA 50208
Phone: 641-792-8451
Fax: 641-792-7989

 3012 Ansborough Ave.
Waterloo, IA 50701
Phone: 319-235-4440
Fax: 319-235-2480

☐ 1304 Adams
Kansas City, KS 66103
Phone: 913-321-7856
Fax: 913-321-7937

PAGE 1 OF 1

PRINT OR TYPE INFORMATION BELOW

SAMPLER: JACK E FRIEDMAN

SITE NAME: BOEING / GKN

ADDRESS:

CITY/ST/ZIP:

PHONE: _____

REPORT TO:

NAME: DENNIS BRINCLEY

COMPANY NAME: MACTEC

ADDRESS: 3199 Riverport Tech Center Dr.

CITY/ST/ZIP: ST LOUIS MO 63043

PHONE: (314) 209-5900

FAX: (314) 209-5929

BILL TO:

NAME: DENNIS BRINDLEY

COMPANY NAME: MACTEC

ADDRESS: 3199 Riverport Tech Center Dr

CITY/ST/ZIP: St Louis MO 63043

PHONE: (314) 201-5900

Keystone Quote No.:

(If Applicable)

[illegible]

Relinquished by: (Signature)

Date 12/16/02

Time 1930

Received by: (Signature)

Date _____

Time

Turn-Around:

☒ Standard

□

Rush

Contact Lab Prior to Submission

Retinquished by: (Signature)

Date

Time

Received for Lab by: (Signature)

Date

Time

Remarks:

Accreditations:
Iowa DNR: 095
New Jersey DEP: 1A001
Kansas DHE: E-10287

ANALYTICAL REPORT

March 20, 2003

Work Order: 13C0609

Page 1 of 1

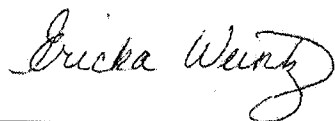
Report To
Dennis Brinkley MACTEC (Harding ESE) 3199 River Port Tech Center St. Louis, MO 63043

Work Order Information
Date Received: 03/18/2003 1:22PM Collector: Phone: 314-567-4600 PO Number:

Project: Boeing/GKN
Project Number: Boeing

Analyte	Result	MRL	Method	Analyst	Analyzed	Qualifier
13C0609-01	MW3BW		Matrix: Water		Collected: 03/17/03 14:05	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	HPLC/UV	JLH	03/18/03 20:31	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:31	
Acetic Acid (C2)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:31	
Propionic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:31	
Butyric Acid (C4)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:31	
13C0609-02	MW3B		Matrix: Water		Collected: 03/17/03 18:15	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	HPLC/UV	JLH	03/18/03 20:52	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:52	
Acetic Acid (C2)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:52	
Propionic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:52	
Butyric Acid (C4)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:52	
13C0609-03	MW3BAW		Matrix: Water		Collected: 03/17/03 16:30	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	HPLC/UV	JLH	03/18/03 21:14	
Lactic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 21:14	
Acetic Acid (C2)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 21:14	
Propionic Acid (C3)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 21:14	
Butyric Acid (C4)	<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 21:14	

End of Report



Keystone Laboratories, Inc.

Ericka Weintz
Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL = Method Reporting Limit.

~~11665 Lilburn Park Road, St. Louis, MO 63146-3535~~
~~Telephone: (314) 567-4600 -- Fax: (314) 567-5030~~

Project Number:

13C0609

Client: MACTEC
Address: 3199 RIVERPORT TECH CENTER DR
ST LOUIS MO 63043

Phone #: (314) 209-5900 Fax #: (314) 209-5929

P.O. #: 300001

P.O. #: _____
Client Contact: DENNIS BRINKLEY

Client Contact: DENNIS DENBEST
Project # / Location: 510098 / Beijing GKU

1. Water
2. Soil
3. Sludge
4. Oil
5. Tissue

Other :

P - Plastic
G - Glass
V - VOC

Preservative:

1. None
2. H_2SO_4
3. HNO_3
4. NaOH
5. HCl

GLASS
VOC

METABOLIC ACIDS (TOTAL)

Ha

Specific Conductivity
Temperature

Comments

[illegible]

Relinquished By:

Date: 3-17-03

Time: 20 : 00

Received By:

Date: -- --

Time: :

Relinquished By:

Date: -- --

Time: _____ : _____

Received For Lab By:

Date: 3-18-03

Time: 13:22

FOR LAB USE ONLY

Samples Received Chilled

☐ Yes ☐ No

Copies: White - Client Canary - Lab Receiving Pink - Lab File Goldenrod - Retained by Sampler

SPECIAL INSTRUCTIONS:

Accreditations:
Iowa DNR: 095
New Jersey DEP: IA001
Kansas DHE: E-10287

ANALYTICAL REPORT

June 26, 2003

Page 1 of 3

Work Order: 13F0789

Report To
Dennis Brinkley
MACTEC E & C - MO
3199 River Port Tech Center
St. Louis, MO 63043

Work Order Information
Date Received: 06/19/2003 9:43AM
Collector: Jack E. Friesney
Phone: 314-567-4600
PO Number:

Project : Boeing/GKN
Project Number: Boeing

Analyte	Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
13F0789-01 MW3BW				Matrix: Water		Collected: 06/18/03 12:30	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1F32535	HPLC/UV	JLH	06/24/03 14:45	
Lactic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 14:45	
Acetic Acid (C2)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 14:45	
Propionic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 14:45	
Butyric Acid (C4)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 14:45	
13F0789-02 MW3AW				Matrix: Water		Collected: 06/18/03 15:10	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1F32535	HPLC/UV	JLH	06/24/03 15:07	
Lactic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 15:07	
Acetic Acid (C2)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 15:07	
Propionic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 15:07	
Butyric Acid (C4)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 15:07	
13F0789-03 MW3W				Matrix: Water		Collected: 06/18/03 16:30	
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1F32535	HPLC/UV	JLH	06/24/03 15:57	
Lactic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 15:57	
Acetic Acid (C2)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 15:57	
Propionic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 15:57	
Butyric Acid (C4)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH	06/24/03 15:57	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL = Method Reporting Limit.

MACTEC E & C - MO
3199 River Port Tech Center
St. Louis, MO 63043

Work Order: 13F0789

June 26, 2003

Page 2 of 3

Determination of Metabolic Acids - Quality Control

Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1F32535 - General Prep HPLC/IC										
Blank (1F32535-BLK1)				Prepared & Analyzed: 06/24/03						
Pyruvic Acid (C3)	ND	0.1	mg/l							
Lactic Acid (C3)	ND	1.0	"							
Acetic Acid (C2)	ND	1.0	"							
Propionic Acid (C3)	ND	1.0	"							
Butyric Acid (C4)	ND	1.0	"							
LCS (1F32535-BS1)				Prepared & Analyzed: 06/24/03						
Pyruvic Acid (C3)	36.60	0.1	mg/l	36.75		99.6	81-136			
Lactic Acid (C3)	180.4	1.0	"	203.7		88.6	64-134			
Acetic Acid (C2)	166.6	1.0	"	150.7		111	82-122			
Propionic Acid (C3)	169.0	1.0	"	162.4		104	90-112			
Butyric Acid (C4)	155.0	1.0	"	152.4		102	88-113			
Calibration Check (1F32535-CCV1)				Prepared & Analyzed: 06/24/03						
Pyruvic Acid (C3)	29.34	0.1	mg/l	28.00		105	80-120			
Lactic Acid (C3)	94.35	1.0	"	98.94		95.4	80-120			
Acetic Acid (C2)	103.1	1.0	"	91.68		112	80-120			
Propionic Acid (C3)	102.3	1.0	"	94.60		108	80-120			
Butyric Acid (C4)	123.7	1.0	"	114.2		108	80-120			
Calibration Check (1F32535-CCV2)				Prepared & Analyzed: 06/24/03						
Pyruvic Acid (C3)	29.42	0.1	mg/l	28.00		105	80-120			
Lactic Acid (C3)	96.81	1.0	"	98.94		97.8	80-120			
Acetic Acid (C2)	97.84	1.0	"	91.68		107	80-120			
Propionic Acid (C3)	99.95	1.0	"	94.60		106	80-120			
Butyric Acid (C4)	115.5	1.0	"	114.2		101	80-120			
Matrix Spike (1F32535-MS1)				Source: 13F0933-01 Prepared & Analyzed: 06/24/03						
Pyruvic Acid (C3)	26.45	0.1	mg/l	24.50	ND	108	85-149			
Lactic Acid (C3)	129.2	1.0	"	135.8	ND	95.1	61-140			
Acetic Acid (C2)	116.3	1.0	"	100.5	ND	116	68-145			
Propionic Acid (C3)	117.2	1.0	"	108.3	ND	108	76-140			
Butyric Acid (C4)	110.1	1.0	"	101.6	ND	108	79-132			

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.

MACTEC E & C - MO
3199 River Port Tech Center
St. Louis, MO 63043

Work Order: 13F0789

June 26, 2003

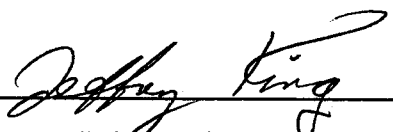
Page 3 of 3

Determination of Metabolic Acids - Quality Control
Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1F32535 - General Prep HPLC/IC										
Matrix Spike Dup (1F32535-MSD1)		Source: 13F0933-01			Prepared & Analyzed: 06/24/03					
Pyruvic Acid (C3)	26.10	9.1	mg/l	24.50	ND	107	85-149	1.33	15	
Lactic Acid (C3)	130.5	1.0	"	135.8	ND	96.1	61-140	1.00	10	
Acetic Acid (C2)	116.6	1.0	"	100.5	ND	116	68-145	0.258	23	
Propionic Acid (C3)	121.5	1.0	"	108.3	ND	112	76-140	3.60	12	
Butyric Acid (C4)	110.7	1.0	"	101.6	ND	109	79-132	0.543	21	

ND = Non Detect; REC= Recovery; RPD= Relative Percent Difference


End of Report



Keystone Laboratories, Inc.
Jeffrey King, Ph.D.
Laboratory Director

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.

Keystone
LABORATORIES, INC.

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Newton, IA 50208
Phone: 641-792-8451
Fax: 641-792-7989

 3012 Ansborough Ave.
Waterloo, IA 50701
Phone: 319-235-4440
Fax: 319-235-2480

 1304 Adams
Kansas City, KS 66103
Phone: 913-321-7856
Fax: 913-321-7937

PAGE 1 OF 1

PRINT OR TYPE INFORMATION BELOW

SAMPLER: JACK E FRIESNEY

SITE NAME: BOEING/GKN

ADDRESS: _____

CITY/ST/ZIP: _____

PHONE: _____

REPORT TO:

NAME: DEONIS BRANKLEY

COMPANY NAME: MACTEC

ADDRESS: 3199 RIVERPORT TECH CENTER DR

CITY/ST/ZIP: St Louis Mo 63043

PHONE: (314) 209-5900

FAX: (314) 209-5929

BILL TO:

NAME: _____

COMPANY NAME: _____

ADDRESS: _____

CITY/ST/ZIP: _____

PHONE: _____

Keystone Quote No.: _____ (If Applicable)

[illegible]

Relinquished by: (Signature)

Date 6/18/03

Time 1900

Received by: (Signature)

Date

Time

Turn-Around:

 **Standard**

☐

Rush

Contact Lab Prior to Submission

Relinquished by: (Signature)

Date

Time

Received for Lab by: (Signature)

Date 6-19-03

Time 9:42

Remarks:



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REPORT OF ANALYSIS

Mr. Dennis Brinkley
MACTEC - St. Louis, MO
3199 Riverport Tech Center Drive
St. Louis, MO 63043

January 20, 2004

Date Received : January 15, 2004
Description : GW - Boeing

Sample ID : MW3AW

Collected By : Jack E Friesner
Collection Date : 01/14/04 14:15

ESC Sample # : L141005-01

Site ID :

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Methane	BDL	1.0	ppm	8015M	01/15/04	1
Chloride	690	5.0	mg/l	9056	01/16/04	5
Nitrate	BDL	0.10	mg/l	9056	01/16/04	1
Nitrite	BDL	0.10	mg/l	9056	01/16/04	1
Sulfate	92.	5.0	mg/l	9056	01/16/04	1
Free Carbon Dioxide	180	20.	mg/l	406B	01/15/04	2
Ethane	BDL	10.	ppm	8015M	01/15/04	1
Ethene	BDL	10.	ppm	8015M	01/15/04	1
DOC	2.6	1.0	mg/l	5310B	01/19/04	1
Sulfide	BDL	0.050	mg/l	9030B	01/16/04	1
TOC (Total Organic Carbon)	1.4	1.0	mg/l	9060	01/15/04	1
Iron	BDL	0.050	mg/l	6010B	01/16/04	1
Iron, Dissolved	0.053	0.050	mg/l	6010B	01/17/04	1
Manganese, Dissolved	0.96	0.010	mg/l	6010B	01/17/04	1
Volatile Organics						
Acetone	BDL	0.050	mg/l	8260B	01/15/04	1
Acrolein	BDL	0.050	mg/l	8260B	01/15/04	1
Acrylonitrile	BDL	0.050	mg/l	8260B	01/15/04	1
Benzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromodichloromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromoform	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
n-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
sec-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
tert-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Carbon tetrachloride	BDL	0.0010	mg/l	8260B	01/15/04	1
Chlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Chlorodibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Chloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



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REPORT OF ANALYSIS

January 20, 2004

Mr. Dennis Brinkley
MACTEC - St. Louis, MO
3199 Riverport Tech Center Drive
St. Louis, MO 63043

ESC Sample # : L141005-01

Date Received : January 15, 2004
Description : GW - Boeing

Site ID :

Sample ID : MW3AW

Project # : 3250035046

Collected By : Jack E Friesner
Collection Date : 01/14/04 14:15

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
2-Chloroethyl vinyl ether	BDL	0.050	mg/l	8260B	01/15/04	1
Chloroform	BDL	0.0050	mg/l	8260B	01/15/04	1
Chloromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
2-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
4-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dibromo-3-Chloropropane	BDL	0.0020	mg/l	8260B	01/15/04	1
1,2-Dibromoethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Dibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,4-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Dichlorodifluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloroethene	0.0015	0.0010	mg/l	8260B	01/15/04	1
cis-1,2-Dichloroethene	0.46	0.0010	mg/l	8260B	01/15/04	1
trans-1,2-Dichloroethene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
cis-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
trans-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
2,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
Di-isopropyl ether	BDL	0.0010	mg/l	8260B	01/15/04	1
Ethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Hexachlorobutadiene	BDL	0.0010	mg/l	8260B	01/15/04	1
Isopropylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
p-Isopropyltoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
2-Butanone (MEK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methylene Chloride	BDL	0.0050	mg/l	8260B	01/15/04	1
4-Methyl-2-pentanone (MIBK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methyl tert-butyl ether	BDL	0.0010	mg/l	8260B	01/15/04	1
Naphthalene	BDL	0.0050	mg/l	8260B	01/15/04	1
n-Propylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Styrene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,1,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2-Trichloro-1,2,2-trifluoro	BDL	0.0010	mg/l	8260B	01/15/04	1
Tetrachloroethene	BDL	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



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REPORT OF ANALYSIS

Mr. Dennis Brinkley
MACTEC - St. Louis, MO
3199 Riverport Tech Center Drive
St. Louis, MO 63043

January 20, 2004

Date Received : January 15, 2004
Description : GW - Boeing

ESC Sample # : L141005-01

Sample ID : MW3AW

Site ID :

Collected By : Jack E Friesner
Collection Date : 01/14/04 14:15

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Toluene	BDL	0.0050	mg/l	8260B	01/15/04	1
1,2,3-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,1-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Trichloroethene	0.29	0.0010	mg/l	8260B	01/15/04	1
Trichlorofluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3,5-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Vinyl chloride	0.013	0.0010	mg/l	8260B	01/15/04	1
Xylenes, Total	BDL	0.0030	mg/l	8260B	01/15/04	1
Surrogate Recovery						
Toluene-d8	98.		% Rec.	8260B	01/15/04	1
Dibromofluoromethane	100		% Rec.	8260B	01/15/04	1
4-Bromofluorobenzene	100		% Rec.	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Note:

The reported analytical results relate only to the sample submitted.

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Reported: 01/20/04 09:23 Printed: 01/20/04 15:02


Jeff Carr, ESC Representative



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Est. 1970

REPORT OF ANALYSIS

January 20, 2004

Mr. Dennis Brinkley
MACTEC - St. Louis, MO
3199 Riverport Tech Center Drive
St. Louis, MO 63043

ESC Sample # : L141005-02

Date Received : January 15, 2004
Description : GW - Boeing

Site ID :

Sample ID : MW3BW

Project # : 3250035046

Collected By : Jack E Friesner
Collection Date : 01/14/04 12:35

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Methane	BDL	1.0	ppm	8015M	01/15/04	1
Chloride	1400	10.	mg/l	9056	01/16/04	10
Nitrate	BDL	0.10	mg/l	9056	01/16/04	1
Nitrite	BDL	0.10	mg/l	9056	01/16/04	1
Sulfate	33.	5.0	mg/l	9056	01/16/04	1
Free Carbon Dioxide	120	10.	mg/l	406B	01/15/04	1
Ethane	BDL	10.	ppm	8015M	01/15/04	1
Ethene	BDL	10.	ppm	8015M	01/15/04	1
DOC	1.4	1.0	mg/l	5310B	01/19/04	1
Sulfide	BDL	0.050	mg/l	9030B	01/16/04	1
TOC (Total Organic Carbon)	BDL	1.0	mg/l	9060	01/15/04	1
Iron	16.	0.050	mg/l	6010B	01/16/04	1
Iron, Dissolved	11.	0.050	mg/l	6010B	01/17/04	1
Manganese, Dissolved	6.7	0.010	mg/l	6010B	01/17/04	1
Volatile Organics						
Acetone	BDL	0.050	mg/l	8260B	01/15/04	1
Acrolein	BDL	0.050	mg/l	8260B	01/15/04	1
Acrylonitrile	BDL	0.050	mg/l	8260B	01/15/04	1
Benzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromodichloromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromoform	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
n-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
sec-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
tert-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Carbon tetrachloride	BDL	0.0010	mg/l	8260B	01/15/04	1
Chlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Chlorodibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Chloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



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(615) 758-5858
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Fax (615) 758-5859

Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley
MACTEC - St. Louis, MO
3199 Riverport Tech Center Drive
St. Louis, MO 63043

January 20, 2004

Date Received : January 15, 2004
Description : GW - Boeing

ESC Sample # : L141005-02

Sample ID : MW3BW

Site ID :

Collected By : Jack E Friesner
Collection Date : 01/14/04 12:35

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
2-Chloroethyl vinyl ether	BDL	0.050	mg/l	8260B	01/15/04	1
Chloroform	BDL	0.0050	mg/l	8260B	01/15/04	1
Chloromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
2-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
4-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dibromo-3-Chloropropane	BDL	0.0020	mg/l	8260B	01/15/04	1
1,2-Dibromoethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Dibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,4-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Dichlorodifluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloroethene	BDL	0.0010	mg/l	8260B	01/15/04	1
cis-1,2-Dichloroethene	0.0062	0.0010	mg/l	8260B	01/15/04	1
trans-1,2-Dichloroethene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
cis-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
trans-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
2,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
Di-isopropyl ether	BDL	0.0010	mg/l	8260B	01/15/04	1
Ethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Hexachlorobutadiene	BDL	0.0010	mg/l	8260B	01/15/04	1
Isopropylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
p-Isopropyltoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
2-Butanone (MEK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methylene Chloride	BDL	0.0050	mg/l	8260B	01/15/04	1
4-Methyl-2-pentanone (MIBK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methyl tert-butyl ether	BDL	0.0010	mg/l	8260B	01/15/04	1
Naphthalene	BDL	0.0050	mg/l	8260B	01/15/04	1
n-Propylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Styrene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,1,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2-Trichloro-1,2,2-trifluoro	BDL	0.0010	mg/l	8260B	01/15/04	1
Tetrachloroethene	BDL	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



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REPORT OF ANALYSIS

January 20, 2004

Mr. Dennis Brinkley
MACTEC - St. Louis, MO
3199 Riverport Tech Center Drive
St. Louis, MO 63043

Date Received : January 15, 2004
Description : GW - Boeing

Sample ID : MW3BW

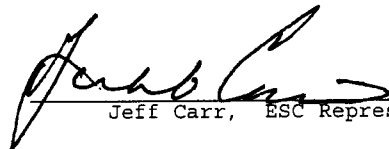
Collected By : Jack E Friesner
Collection Date : 01/14/04 12:35

ESC Sample # : L141005-02

Site ID :

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Toluene	BDL	0.0050	mg/l	8260B	01/15/04	1
1,2,3-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,1-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Trichloroethene	BDL	0.0010	mg/l	8260B	01/15/04	1
Trichlorofluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3,5-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Vinyl chloride	0.0018	0.0010	mg/l	8260B	01/15/04	1
Xylenes, Total	BDL	0.0030	mg/l	8260B	01/15/04	1
Surrogate Recovery						
Toluene-d8	100		% Rec.	8260B	01/15/04	1
Dibromofluoromethane	100		% Rec.	8260B	01/15/04	1
4-Bromofluorobenzene	100		% Rec.	8260B	01/15/04	1


Jeff Carr, ESC Representative

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Note:

The reported analytical results relate only to the sample submitted.

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Reported: 01/20/04 09:23 Printed: 01/20/04 15:02



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REPORT OF ANALYSIS

Mr. Dennis Brinkley
MACTEC - St. Louis, MO
3199 Riverport Tech Center Drive
St. Louis, MO 63043

January 20, 2004

Date Received : January 15, 2004
Description : GW - Boeing

ESC Sample # : L141005-03

Sample ID : MW3W

Site ID :

Collected By : Jack E Friesner
Collection Date : 01/14/04 16:30

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Methane	1.6	1.0	ppm	8015M	01/15/04	1
Chloride	480	5.0	mg/l	9056	01/16/04	5
Nitrate	BDL	0.10	mg/l	9056	01/16/04	1
Nitrite	BDL	0.10	mg/l	9056	01/16/04	1
Sulfate	41.	5.0	mg/l	9056	01/16/04	1
Free Carbon Dioxide	140	50.	mg/l	406B	01/15/04	5
Ethane	BDL	10.	ppm	8015M	01/15/04	1
Ethene	BDL	10.	ppm	8015M	01/15/04	1
DOC	2.0	1.0	mg/l	5310B	01/19/04	1
Sulfide	0.077	0.050	mg/l	9030B	01/16/04	1
TOC (Total Organic Carbon)	1.7	1.0	mg/l	9060	01/15/04	1
Iron	5.8	0.050	mg/l	6010B	01/16/04	1
Iron, Dissolved	0.70	0.050	mg/l	6010B	01/17/04	1
Manganese, Dissolved	2.1	0.010	mg/l	6010B	01/17/04	1
Volatile Organics						
Acetone	BDL	0.050	mg/l	8260B	01/15/04	1
Acrolein	BDL	0.050	mg/l	8260B	01/15/04	1
Acrylonitrile	BDL	0.050	mg/l	8260B	01/15/04	1
Benzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromodichloromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromoform	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
n-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
sec-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
tert-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Carbon tetrachloride	BDL	0.0010	mg/l	8260B	01/15/04	1
Chlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Chlorodibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Chloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



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3199 Riverport Tech Center Drive
St. Louis, MO 63043

January 20, 2004

Date Received : January 15, 2004
Description : GW - Boeing

ESC Sample # : L141005-03

Sample ID : MW3W

Site ID :

Collected By : Jack E Friesner
Collection Date : 01/14/04 16:30

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
2-Chloroethyl vinyl ether	BDL	0.050	mg/l	8260B	01/15/04	1
Chloroform	BDL	0.0050	mg/l	8260B	01/15/04	1
Chloromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
2-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
4-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dibromo-3-Chloropropane	BDL	0.0020	mg/l	8260B	01/15/04	1
1,2-Dibromoethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Dibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,4-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Dichlorodifluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloroethene	0.014	0.0010	mg/l	8260B	01/15/04	1
cis-1,2-Dichloroethene	2.6	0.0010	mg/l	8260B	01/15/04	1
trans-1,2-Dichloroethene	0.10	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
cis-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
trans-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
2,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
Di-isopropyl ether	BDL	0.0010	mg/l	8260B	01/15/04	1
Ethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Hexachlorobutadiene	BDL	0.0010	mg/l	8260B	01/15/04	1
Isopropylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
p-Isopropyltoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
2-Butanone (MEK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methylene Chloride	BDL	0.0050	mg/l	8260B	01/15/04	1
4-Methyl-2-pentanone (MIBK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methyl tert-butyl ether	BDL	0.0010	mg/l	8260B	01/15/04	1
Naphthalene	BDL	0.0050	mg/l	8260B	01/15/04	1
n-Propylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Styrene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,1,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2-Trichloro-1,2,2-trifluoro	BDL	0.0010	mg/l	8260B	01/15/04	1
Tetrachloroethene	BDL	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
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REPORT OF ANALYSIS

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3199 Riverport Tech Center Drive
St. Louis, MO 63043

January 20, 2004

Date Received : January 15, 2004
Description : GW - Boeing

Sample ID : MW3W

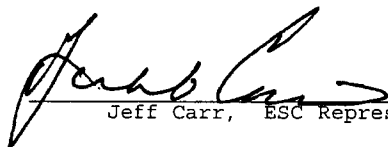
Collected By : Jack E Friesner
Collection Date : 01/14/04 16:30

ESC Sample # : L141005-03

Site ID :

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Toluene	BDL	0.0050	mg/l	8260B	01/15/04	1
1,2,3-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,1-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Trichloroethene	0.034	0.0010	mg/l	8260B	01/15/04	1
Trichlorofluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3,5-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Vinyl chloride	1.0	0.0010	mg/l	8260B	01/15/04	1
Xylenes, Total	BDL	0.0030	mg/l	8260B	01/15/04	1
Surrogate Recovery						
Toluene-d8	100		% Rec.	8260B	01/15/04	1
Dibromofluoromethane	100		% Rec.	8260B	01/15/04	1
4-Bromofluorobenzene	100		% Rec.	8260B	01/15/04	1


Jeff Carr, ESC Representative

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Note:

The reported analytical results relate only to the sample submitted.

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Reported: 01/20/04 09:23 Printed: 01/20/04 15:02

Attachment A
List of Analytes with QC Qualifiers

Sample #	Analyte	Qualifier
L141005-01	DOC	W
	Chloride	J4
	Acrolein	J4
	Bromodichloromethane	J3
	Bromomethane	J3
	2-Chloroethyl vinyl ether	J4J3
	Dibromomethane	J3
	cis-1,2-Dichloroethene	E
	1,2-Dichloropropane	J3
	2-Butanone (MEK)	J3
	4-Methyl-2-pentanone (MIBK)	J3
	Trichloroethene	E
	1,2,3-Trichloropropane	J3
L141005-02	DOC	W
	Chloride	J4
	Nitrite	L Q
	Acrolein	J4J5
	Acrylonitrile	J3
	2-Chloroethyl vinyl ether	J4
	2-Butanone (MEK)	J3
	Methyl tert-butyl ether	J5
	1,1,2,2-Tetrachloroethane	J3
L141005-03	DOC	W
	Chloride	J4
	Acrolein	J4
	Bromodichloromethane	J3
	Bromomethane	J3
	2-Chloroethyl vinyl ether	J4J3
	Dibromomethane	J3
	cis-1,2-Dichloroethene	E
	1,2-Dichloropropane	J3
	2-Butanone (MEK)	J3
	4-Methyl-2-pentanone (MIBK)	J3
	1,2,3-Trichloropropane	J3
	Vinyl chloride	E

Attachment B
Explanation of QC Qualifier Codes

Qualifier	Meaning
E	GTL (EPA) - Greater than upper calibration limit: Actual value is known to be greater than the upper calibration range.
J3	The associated batch QC was outside the established quality control range for precision.
J4	The associated batch QC was outside the established quality control range for accuracy.
J5	The sample matrix interfered with the ability to make any accurate determination; spike value is high
Q	(ESC) Sample held beyond the accepted holding time.
L	(ESC) Sample Pretreatment: The sample reaction impaired the ability to analyze the sample using normal analytical determination. Treatment outside of method protocol was required to determine the analytical result.
W	(ESC)-The laboratory analysis was from a sample collected in an improper container

Qualifier Report Information

ESC utilizes sample and result qualifiers as set forth by the EPA Contract Laboratory Program and as required by most certifying bodies including NELAC. In addition to the EPA qualifiers adopted by ESC, we have implemented ESC qualifiers to provide more information pertaining to our analytical results. Each qualifier is designated in the qualifier explanation as either EPA or ESC. Data qualifiers are intended to provide the ESC client with more detailed information concerning the potential bias of reported data. Because of the wide range of constituents and variety of matrices incorporated by most EPA methods, it is common for some compounds to fall outside of established ranges. These exceptions are evaluated and all reported data is valid and useable unless qualified as 'R' (Rejected).

Definitions

Accuracy - The relationship of the observed value of a known sample to the true value of a known sample. Represented by percent recovery and relevant to samples such as: control samples, matrix spike recoveries, surrogate recoveries, etc.

Precision - The agreement between a set of samples or between duplicate samples. Relates to how close together the results are and is represented by Relative Percent Difference.

Surrogate - Organic compounds that are similar in chemical composition, extraction, and chromatography to analytes of interest. The surrogates are used to determine the probable response of the group of analytes that are chemically related to the surrogate compound. Surrogates are added to the sample and carried through all stages of preparation and analyses.

Control Limits

2-Fluorophenol	31-119	Nitrobenzene-d5	43-118	Dibromfluoromethane	79-126	83-119
Phenol-d5	12-134	2-Fluorobiphenyl	45-128	Toluene-d8	81-114	82-116
2,4,6-Tribromophenol	51-141	Terphenyl-d14	43-137	4-Bromofluorobenzene	65-129	72-126

TIC - Tentatively Identified Compound: Compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates.

Summary of Remarks For Samples Printed
01/20/04 at 15:02:58

TSR Signing Reports: 206
R5 - Desired TAT

Needs EDD in PPB format.

Sample: L141005-01 Account: HARDMO Received: 01/15/04 09:30 Due Date: 01/22/04 00:00 RPT Date: 01/20/04 09:23
Needs EDD PPM FORMAT
Sample: L141005-02 Account: HARDMO Received: 01/15/04 09:30 Due Date: 01/22/04 00:00 RPT Date: 01/20/04 09:23
Needs EDD PPM FORMAT
Sample: L141005-03 Account: HARDMO Received: 01/15/04 09:30 Due Date: 01/22/04 00:00 RPT Date: 01/20/04 09:23
Needs EDD PPM FORMAT



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MACTEC - St. Louis, MO
Mr. Dennis Brinkley
3199 Riverport Tech Center Drive
St. Louis, MO 63043

Quality Assurance Report Level II

L141005

January 20, 2004

Analyte	Result	Laboratory Blank		Date Analyzed	Batch
		Units			
Nitrate	< .1	mg/l	01/15/04 18:08	WG140525	
Nitrite	< .1	mg/l	01/15/04 18:08	WG140525	
Sulfate	< 5	mg/l	01/15/04 18:08	WG140525	
TOC (Total Organic Carbon)	< 1	mg/l	01/15/04 13:17	WG140588	
Iron	< .05	mg/l	01/16/04 02:18	WG140610	
Free Carbon Dioxide	< 10	mg/l	01/15/04 17:30	WG140619	
1,1,1,2-Tetrachloroethane	< .001	mg/l	01/15/04 14:36	WG140662	
1,1,1-Trichloroethane	< .001	mg/l	01/15/04 14:36	WG140662	
1,1,2,2-Tetrachloroethane	< .001	mg/l	01/15/04 14:36	WG140662	
1,1,2-Trichloro-1,2,2-trifluoroethane	< .001	mg/l	01/15/04 14:36	WG140662	
1,1,2-Trichloroethane	< .001	mg/l	01/15/04 14:36	WG140662	
1,1-Dichloroethane	< .001	mg/l	01/15/04 14:36	WG140662	
1,1-Dichloroethene	< .001	mg/l	01/15/04 14:36	WG140662	
1,1-Dichloropropene	< .001	mg/l	01/15/04 14:36	WG140662	
1,2,3-Trichlorobenzene	< .001	mg/l	01/15/04 14:36	WG140662	
1,2,3-Trichloropropane	< .001	mg/l	01/15/04 14:36	WG140662	
1,2,3-Trimethylbenzene	< .001	mg/l	01/15/04 14:36	WG140662	
1,2,4-Trichlorobenzene	< .001	mg/l	01/15/04 14:36	WG140662	
1,2,4-Trimethylbenzene	< .001	mg/l	01/15/04 14:36	WG140662	
1,2-Dibromo-3-Chloropropane	< .002	mg/l	01/15/04 14:36	WG140662	
1,2-Dibromoethane	< .001	mg/l	01/15/04 14:36	WG140662	
1,2-Dichlorobenzene	< .001	mg/l	01/15/04 14:36	WG140662	
1,2-Dichloroethane	< .001	mg/l	01/15/04 14:36	WG140662	
1,2-Dichloropropane	< .001	mg/l	01/15/04 14:36	WG140662	
1,3,5-Trimethylbenzene	< .001	mg/l	01/15/04 14:36	WG140662	
1,3-Dichlorobenzene	< .001	mg/l	01/15/04 14:36	WG140662	
1,3-Dichloropropane	< .001	mg/l	01/15/04 14:36	WG140662	
1,4-Dichlorobenzene	< .001	mg/l	01/15/04 14:36	WG140662	
2,2-Dichloropropane	< .001	mg/l	01/15/04 14:36	WG140662	
2-Butanone (MEK)	< .05	mg/l	01/15/04 14:36	WG140662	
2-Chloroethyl vinyl ether	< .05	mg/l	01/15/04 14:36	WG140662	
2-Chlorotoluene	< .001	mg/l	01/15/04 14:36	WG140662	
4-Chlorotoluene	< .001	mg/l	01/15/04 14:36	WG140662	
4-Methyl-2-pentanone (MIBK)	< .05	mg/l	01/15/04 14:36	WG140662	
Acetone	< .05	mg/l	01/15/04 14:36	WG140662	
Acrolein	< .05	mg/l	01/15/04 14:36	WG140662	
Acrylonitrile	< .05	mg/l	01/15/04 14:36	WG140662	
Benzene	< .001	mg/l	01/15/04 14:36	WG140662	
Bromobenzene	< .001	mg/l	01/15/04 14:36	WG140662	
Bromodichloromethane	< .001	mg/l	01/15/04 14:36	WG140662	
Bromoform	< .001	mg/l	01/15/04 14:36	WG140662	
Bromomethane	< .001	mg/l	01/15/04 14:36	WG140662	
Carbon tetrachloride	< .001	mg/l	01/15/04 14:36	WG140662	
Chlorobenzene	< .001	mg/l	01/15/04 14:36	WG140662	
Chlorodibromomethane	< .001	mg/l	01/15/04 14:36	WG140662	
Chloroethane	< .001	mg/l	01/15/04 14:36	WG140662	
Chloroform	< .005	mg/l	01/15/04 14:36	WG140662	
Chloromethane	< .001	mg/l	01/15/04 14:36	WG140662	
cis-1,2-Dichloroethene	< .001	mg/l	01/15/04 14:36	WG140662	
cis-1,3-Dichloropropene	< .001	mg/l	01/15/04 14:36	WG140662	
Di-isopropyl ether	< .001	mg/l	01/15/04 14:36	WG140662	
Dibromomethane	< .001	mg/l	01/15/04 14:36	WG140662	
Dichlorodifluoromethane	< .001	mg/l	01/15/04 14:36	WG140662	
Ethylbenzene	< .001	mg/l	01/15/04 14:36	WG140662	
Hexachlorobutadiene	< .001	mg/l	01/15/04 14:36	WG140662	
Isopropylbenzene	< .001	mg/l	01/15/04 14:36	WG140662	



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St. Louis, MO 63043

Quality Assurance Report Level II

L141005

January 20, 2004

Methyl tert-butyl ether	< .001	mg/l	01/15/04 14:36	WG140662
Laboratory Blank				
Analyte	Result	Units	Date Analyzed	Batch
Methylene Chloride	< .005	mg/l	01/15/04 14:36	WG140662
n-Butylbenzene	< .001	mg/l	01/15/04 14:36	WG140662
n-Propylbenzene	< .001	mg/l	01/15/04 14:36	WG140662
Naphthalene	< .005	mg/l	01/15/04 14:36	WG140662
p-Isopropyltoluene	< .001	mg/l	01/15/04 14:36	WG140662
sec-Butylbenzene	< .001	mg/l	01/15/04 14:36	WG140662
Styrene	< .001	mg/l	01/15/04 14:36	WG140662
tert-Butylbenzene	< .001	mg/l	01/15/04 14:36	WG140662
Tetrachloroethene	< .001	mg/l	01/15/04 14:36	WG140662
Toluene	< .005	mg/l	01/15/04 14:36	WG140662
trans-1,2-Dichloroethene	< .001	mg/l	01/15/04 14:36	WG140662
trans-1,3-Dichloropropene	< .001	mg/l	01/15/04 14:36	WG140662
Trichloroethene	< .001	mg/l	01/15/04 14:36	WG140662
Trichlorofluoromethane	< .001	mg/l	01/15/04 14:36	WG140662
Vinyl chloride	< .001	mg/l	01/15/04 14:36	WG140662
Xylenes, Total	< .003	mg/l	01/15/04 14:36	WG140662
Iron, Dissolved	< .05	mg/l	01/17/04 01:16	WG140681
Manganese, Dissolved	< .01	mg/l	01/17/04 01:16	WG140681
Chloride	< 1	mg/l	01/16/04 18:17	WG140706
Nitrite	< .1	mg/l	01/16/04 18:17	WG140706
Sulfide	< .05	mg/l	01/16/04 15:00	WG140829
DOC	< 1	mg/l	01/19/04 11:44	WG140996

Analyte	Units	Duplicate		RPD	Limit	Ref Samp	Batch
		Result	Duplicate				
Nitrate	mg/l	0.00	0.00	0.00	20	L141005-03	WG140525
Nitrite	mg/l	0.00	0.00	0.00	20	L141005-03	WG140525
Sulfate	mg/l	40.8	41.0	0.585	20	L141005-03	WG140525
TOC (Total Organic Carbon)	mg/l	0.00	0.00	0.00	20	L140971-02	WG140588
Free Carbon Dioxide	mg/l	119.	120.	0.837	20	L141005-02	WG140619
Sulfide	mg/l	0.0848	0.0770	9.64	20	L141005-03	WG140829
DOC	mg/l	1.23	1.40	13.0	20	L141005-02	WG140996

Analyte	Units	Laboratory Control Sample		% Rec	Limit	Batch
		Known Val	Result			
Nitrate	mg/l	4	3.68	92.0	90-110	WG140525
Nitrite	mg/l	4	3.55	88.8	85-115	WG140525
Sulfate	mg/l	20	17.7	88.6	90-110	WG140525
TOC (Total Organic Carbon)	mg/l	4	4.40	110.	85-115	WG140588
Iron	mg/l	1.13	1.04	92.0	85-115	WG140610
1,1,1,2-Tetrachloroethane	mg/l	.02	0.0211	105.	84-128	WG140662
1,1,1-Trichloroethane	mg/l	.02	0.0181	90.5	71-122	WG140662
1,1,2,2-Tetrachloroethane	mg/l	.02	0.0210	105.	78-120	WG140662
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/l	.02	0.0157	78.5	37-127	WG140662
1,1,2-Trichloroethane	mg/l	.02	0.0190	95.2	82-117	WG140662
1,1-Dichloroethane	mg/l	.02	0.0188	94.2	59-135	WG140662



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L141005

1,1-Dichloroethene	mg/l	.02	0.0182	90.8	60-166	WG140662
Analyte	Units	Laboratory Control Known Val	Sample Result	% Rec	Limit	Batch
1,1-Dichloropropene	mg/l	.02	0.0172	85.8	67-132	WG140662
1,2,3-Trichlorobenzene	mg/l	.02	0.0210	105.	81-122	WG140662
1,2,3-Trichloropropane	mg/l	.02	0.0205	102.	78-122	WG140662
1,2,3-Trimethylbenzene	mg/l	.02	0.0169	84.3	64-100	WG140662
1,2,4-Trichlorobenzene	mg/l	.02	0.0214	107.	78-132	WG140662
1,2,4-Trimethylbenzene	mg/l	.02	0.0204	102.	82-117	WG140662
1,2-Dibromo-3-Chloropropane	mg/l	.02	0.0201	101.	58-140	WG140662
1,2-Dibromoethane	mg/l	.02	0.0203	101.	79-121	WG140662
1,2-Dichlorobenzene	mg/l	.02	0.0195	97.3	83-113	WG140662
1,2-Dichloroethane	mg/l	.02	0.0197	98.5	81-122	WG140662
1,2-Dichloropropane	mg/l	.02	0.0247	124.	74-125	WG140662
1,3,5-Trimethylbenzene	mg/l	.02	0.0197	98.4	80-118	WG140662
1,3-Dichlorobenzene	mg/l	.02	0.0209	104.	80-124	WG140662
1,3-Dichloropropane	mg/l	.02	0.0202	101.	86-120	WG140662
1,4-Dichlorobenzene	mg/l	.02	0.0194	97.2	84-115	WG140662
2,2-Dichloropropane	mg/l	.02	0.0192	95.9	71-131	WG140662
2-Butanone (MEK)	mg/l	.1	0.106	106.	25-137	WG140662
2-Chloroethyl vinyl ether	mg/l	.1	0.00188	1.88	15-161	WG140662
2-Chlorotoluene	mg/l	.02	0.0192	96.1	79-112	WG140662
4-Chlorotoluene	mg/l	.02	0.0198	99.0	82-116	WG140662
4-Methyl-2-pentanone (MIBK)	mg/l	.1	0.108	108.	57-145	WG140662
Acetone	mg/l	.1	0.0916	91.6	14-115	WG140662
Acrolein	mg/l	.1	0.201	201.	16-83	WG140662
Acrylonitrile	mg/l	.1	0.0916	91.6	32-142	WG140662
Benzene	mg/l	.02	0.0187	93.3	66-127	WG140662
Bromobenzene	mg/l	.02	0.0207	104.	79-127	WG140662
Bromodichloromethane	mg/l	.02	0.0218	109.	76-117	WG140662
Bromoform	mg/l	.02	0.0220	110.	72-125	WG140662
Bromomethane	mg/l	.02	0.0102	51.1	25-170	WG140662
Carbon tetrachloride	mg/l	.02	0.0180	89.9	65-127	WG140662
Chlorobenzene	mg/l	.02	0.0195	97.6	79-117	WG140662
Chlorodibromomethane	mg/l	.02	0.0197	98.3	76-115	WG140662
Chloroethane	mg/l	.02	0.0133	66.7	37-130	WG140662
Chloroform	mg/l	.02	0.0191	95.6	70-119	WG140662
Chloromethane	mg/l	.02	0.0104	52.0	39-109	WG140662
cis-1,2-Dichloroethene	mg/l	.02	0.0185	92.5	72-128	WG140662
cis-1,3-Dichloropropene	mg/l	.02	0.0210	105.	86-137	WG140662
Di-isopropyl ether	mg/l	.02	0.0207	103.	54-147	WG140662
Dibromomethane	mg/l	.02	0.0217	109.	81-117	WG140662
Dichlorodifluoromethane	mg/l	.02	0.00559	28.0	14-133	WG140662
Ethylbenzene	mg/l	.02	0.0187	93.6	75-117	WG140662
Hexachlorobutadiene	mg/l	.02	0.0176	87.8	68-122	WG140662
Isopropylbenzene	mg/l	.02	0.0173	86.5	67-113	WG140662
Methyl tert-butyl ether	mg/l	.02	0.0218	109.	65-128	WG140662
Methylene Chloride	mg/l	.02	0.0191	95.4	60-127	WG140662
n-Butylbenzene	mg/l	.02	0.0188	94.1	74-125	WG140662
n-Propylbenzene	mg/l	.02	0.0191	95.5	74-120	WG140662
Naphthalene	mg/l	.02	0.0183	91.6	51-127	WG140662
p-Isopropyltoluene	mg/l	.02	0.0196	97.9	74-122	WG140662
sec-Butylbenzene	mg/l	.02	0.0182	90.9	66-118	WG140662
Styrene	mg/l	.02	0.0198	99.2	78-114	WG140662
tert-Butylbenzene	mg/l	.02	0.0201	101.	69-121	WG140662
Tetrachloroethene	mg/l	.02	0.0187	93.3	71-132	WG140662
Toluene	mg/l	.02	0.0194	97.1	68-122	WG140662
trans-1,2-Dichloroethene	mg/l	.02	0.0176	88.0	65-141	WG140662
trans-1,3-Dichloropropene	mg/l	.02	0.0198	98.8	82-132	WG140662
Trichloroethene	mg/l	.02	0.0181	90.7	81-129	WG140662
Trichlorofluoromethane	mg/l	.02	0.0125	62.7	46-94	WG140662
Vinyl chloride	mg/l	.02	0.0115	57.6	40-95	WG140662



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Xylenes, Total	mg/l	.06	0.0574	95.7	78-114	WG140662
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Analyte	Units	Laboratory Control Known Val	Sample Result	% Rec	Limit	Batch
Iron, Dissolved	mg/l	1.13	1.19	105.	85-115	WG140681
Manganese, Dissolved	mg/l	1.13	1.20	106.	85-115	WG140681
Chloride	mg/l	20	17.0	85.1	90-110	WG140706
Nitrite	mg/l	4	3.56	89.1	85-115	WG140706
Sulfide	mg/l	.5	0.530	106.	85-115	WG140829
DOC	mg/l	4	4.60	115.	85-115	WG140996

Analyte	Units	Laboratory Control LCS Res	Sample Ref Res	Duplicate RPD	Limit	Ref Samp	Batch
Nitrate	mg/l	3.62	3.68	1.59	20	R184382-5	WG140525
Nitrite	mg/l	3.54	3.55	0.421	20	R184382-5	WG140525
Sulfate	mg/l	17.6	17.7	0.872	20	R184382-5	WG140525
TOC (Total Organic Carbon)	mg/l	4.30	4.40	2.30	20	WG140588-2	WG140588
Iron	mg/l	1.06	1.04	1.90	20	R184336-3	WG140610
1,1,1,2-Tetrachloroethane	mg/l	0.0208	0.0211	1.24	16	R184421-5	WG140662
1,1,1-Trichloroethane	mg/l	0.0177	0.0181	2.52	28	R184421-5	WG140662
1,1,2,2-Tetrachloroethane	mg/l	0.0198	0.0210	5.83	10	R184421-5	WG140662
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/l	0.0151	0.0157	3.70	40	R184421-5	WG140662
1,1,2-Trichloroethane	mg/l	0.0184	0.0190	3.31	16	R184421-5	WG140662
1,1-Dichloroethane	mg/l	0.0189	0.0188	0.424	17	R184421-5	WG140662
1,1-Dichloroethene	mg/l	0.0175	0.0182	3.64	36	R184421-5	WG140662
1,1-Dichloropropene	mg/l	0.0168	0.0172	1.88	33	R184421-5	WG140662
1,2,3-Trichlorobenzene	mg/l	0.0199	0.0210	5.39	17	R184421-5	WG140662
1,2,3-Trichloropropane	mg/l	0.0179	0.0205	13.5	13	R184421-5	WG140662
1,2,3-Trimethylbenzene	mg/l	0.0168	0.0169	0.535	20	R184421-5	WG140662
1,2,4-Trichlorobenzene	mg/l	0.0210	0.0214	1.65	25	R184421-5	WG140662
1,2,4-Trimethylbenzene	mg/l	0.0204	0.0204	0.245	29	R184421-5	WG140662
1,2-Dibromo-3-Chloropropane	mg/l	0.0172	0.0201	15.8	21	R184421-5	WG140662
1,2-Dibromoethane	mg/l	0.0190	0.0203	6.31	19	R184421-5	WG140662
1,2-Dichlorobenzene	mg/l	0.0188	0.0195	3.29	16	R184421-5	WG140662
1,2-Dichloroethane	mg/l	0.0185	0.0197	6.45	13	R184421-5	WG140662
1,2-Dichloropropane	mg/l	0.0196	0.0247	23.0	14	R184421-5	WG140662
1,3,5-Trimethylbenzene	mg/l	0.0198	0.0197	0.608	28	R184421-5	WG140662
1,3-Dichlorobenzene	mg/l	0.0209	0.0209	0.0480	25	R184421-5	WG140662
1,3-Dichloropropane	mg/l	0.0193	0.0202	4.46	15	R184421-5	WG140662
1,4-Dichlorobenzene	mg/l	0.0193	0.0194	0.930	18	R184421-5	WG140662
2,2-Dichloropropane	mg/l	0.0184	0.0192	3.93	31	R184421-5	WG140662
2-Butanone (MEK)	mg/l	0.0946	0.106	11.1	10	R184421-5	WG140662
2-Chloroethyl vinyl ether	mg/l	0.0014	0.0018	27.9	25	R184421-5	WG140662
2-Chlorotoluene	mg/l	0.0192	0.0192	0.156	24	R184421-5	WG140662
4-Chlorotoluene	mg/l	0.0194	0.0198	2.09	22	R184421-5	WG140662
4-Methyl-2-pentanone (MIBK)	mg/l	0.0951	0.108	12.5	12	R184421-5	WG140662
Acetone	mg/l	0.0795	0.0916	14.1	20	R184421-5	WG140662
Acrolein	mg/l	0.214	0.201	6.55	34	R184421-5	WG140662
Acrylonitrile	mg/l	0.0852	0.0916	7.20	13	R184421-5	WG140662
Benzene	mg/l	0.0185	0.0187	0.699	20	R184421-5	WG140662
Bromobenzene	mg/l	0.0204	0.0207	1.65	22	R184421-5	WG140662
Bromodichloromethane	mg/l	0.0189	0.0218	14.3	13	R184421-5	WG140662
Bromoform	mg/l	0.0205	0.0220	6.97	18	R184421-5	WG140662
Bromomethane	mg/l	0.0082	0.0102	21.5	20	R184421-5	WG140662
Carbon tetrachloride	mg/l	0.0175	0.0180	2.53	36	R184421-5	WG140662
Chlorobenzene	mg/l	0.0193	0.0195	1.39	21	R184421-5	WG140662



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Chlorodibromomethane	mg/l	0.0186	0.0197	5.54	17	R184421-5	WG140662
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Analyte	Units	Laboratory Control		Sample Duplicate		Limit	Ref Samp	Batch
		LCSD Res	Ref Res	RPD	RPD			
Chloroethane	mg/l	0.0126	0.0133	6.10	25		R184421-5	WG140662
Chloroform	mg/l	0.0194	0.0191	1.35	26		R184421-5	WG140662
Chloromethane	mg/l	0.0097	0.0104	6.97	31		R184421-5	WG140662
cis-1,2-Dichloroethene	mg/l	0.0181	0.0185	2.24	18		R184421-5	WG140662
cis-1,3-Dichloropropene	mg/l	0.0203	0.0210	3.53	17		R184421-5	WG140662
Di-isopropyl ether	mg/l	0.0207	0.0207	0.386	13		R184421-5	WG140662
Dibromomethane	mg/l	0.0182	0.0217	17.5	12		R184421-5	WG140662
Dichlorodifluoromethane	mg/l	0.0053	0.0055	3.83	28		R184421-5	WG140662
Ethylbenzene	mg/l	0.0188	0.0187	0.160	25		R184421-5	WG140662
Hexachlorobutadiene	mg/l	0.0165	0.0176	5.99	36		R184421-5	WG140662
Isopropylbenzene	mg/l	0.0169	0.0173	2.04	29		R184421-5	WG140662
Methyl tert-butyl ether	mg/l	0.0208	0.0218	4.84	16		R184421-5	WG140662
Methylene Chloride	mg/l	0.0187	0.0191	2.07	16		R184421-5	WG140662
n-Butylbenzene	mg/l	0.0187	0.0188	0.587	30		R184421-5	WG140662
n-Propylbenzene	mg/l	0.0190	0.0191	0.473	30		R184421-5	WG140662
Naphthalene	mg/l	0.0166	0.0183	9.67	39		R184421-5	WG140662
p-Isopropyltoluene	mg/l	0.0198	0.0196	0.916	36		R184421-5	WG140662
sec-Butylbenzene	mg/l	0.0184	0.0182	1.09	32		R184421-5	WG140662
Styrene	mg/l	0.0199	0.0198	0.151	21		R184421-5	WG140662
tert-Butylbenzene	mg/l	0.0200	0.0201	0.398	30		R184421-5	WG140662
Tetrachloroethene	mg/l	0.0188	0.0187	0.854	32		R184421-5	WG140662
Toluene	mg/l	0.0191	0.0194	1.87	17		R184421-5	WG140662
trans-1,2-Dichloroethene	mg/l	0.0176	0.0176	0.00	27		R184421-5	WG140662
trans-1,3-Dichloropropene	mg/l	0.0187	0.0198	5.62	16		R184421-5	WG140662
Trichloroethene	mg/l	0.0178	0.0181	1.72	25		R184421-5	WG140662
Trichlorofluoromethane	mg/l	0.0120	0.0125	4.65	41		R184421-5	WG140662
Vinyl chloride	mg/l	0.0109	0.0115	5.81	36		R184421-5	WG140662
Xylenes, Total	mg/l	0.0586	0.0574	2.05	21		R184421-5	WG140662
Iron, Dissolved	mg/l	1.21	1.19	1.67	20		R184440-3	WG140681
Manganese, Dissolved	mg/l	1.20	1.20	0.00	20		R184440-3	WG140681
Chloride	mg/l	16.7	17.0	1.66	20		R184491-2	WG140706
Nitrite	mg/l	3.51	3.56	1.51	20		R184491-2	WG140706
Sulfide	mg/l	0.500	0.530	5.83	20		WG140829-2	WG140829
DOC	mg/l	3.90	4.60	16.5	20		WG140996-2	WG140996

Analyte	Units	Matrix Spike		TV	% Rec	Limit	Ref Samp	Batch
		MS Res	Ref Res					
Nitrate	mg/l	4.74	0.0228	5	94.4	80-120	L140643-21	WG140525
Nitrite	mg/l	4.72	0.00	5	94.5	80-120	L140643-21	WG140525
Sulfate	mg/l	48.2	0.00	50	96.4	80-120	L140643-21	WG140525
TOC (Total Organic Carbon)	mg/l	20.0	0.00	20	100.	80-120	L140971-01	WG140588
Iron	mg/l	1.05	0.00	1.13	93.0	75-125	L141005-01	WG140610
1,1,1,2-Tetrachloroethane	mg/l	0.0210	0.00	0.02	105.	67-139	L141005-02	WG140662
1,1,1-Trichloroethane	mg/l	0.0183	0.00	0.02	91.4	46-143	L141005-02	WG140662
1,1,2,2-Tetrachloroethane	mg/l	0.0211	0.00	0.02	105.	70-116	L141005-02	WG140662
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/l	0.0190	0.00	0.02	94.8	30-134	L141005-02	WG140662
1,1,2-Trichloroethane	mg/l	0.0174	0.00	0.02	87.0	70-122	L141005-02	WG140662
1,1-Dichloroethane	mg/l	0.0203	0.00	0.02	102.	47-138	L141005-02	WG140662
1,1-Dichloroethene	mg/l	0.0218	0.00	0.02	109.	56-162	L141005-02	WG140662
1,1-Dichloropropene	mg/l	0.0187	0.00	0.02	93.7	49-140	L141005-02	WG140662
1,2,3-Trichlorobenzene	mg/l	0.0155	0.00	0.02	77.4	63-124	L141005-02	WG140662



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L141005

1,2,3-Trichloropropane mg/l 0.0192 0.00 0.02 95.9 66-124 L141005-02 WG140662

Analyte	Units	Matrix MS Res	Spike Ref Res	TV	% Rec	Limit	Ref Samp	Batch
1,2,3-Trimethylbenzene	mg/l	0.0163	0.00	0.02	81.7	51-109	L141005-02	WG140662
1,2,4-Trichlorobenzene	mg/l	0.0151	0.00	0.02	75.6	52-130	L141005-02	WG140662
1,2,4-Trimethylbenzene	mg/l	0.0220	0.00	0.02	110.	62-126	L141005-02	WG140662
1,2-Dibromo-3-Chloropropane	mg/l	0.0199	0.00	0.02	99.5	48-122	L141005-02	WG140662
1,2-Dibromoethane	mg/l	0.0206	0.00	0.02	103.	74-121	L141005-02	WG140662
1,2-Dichlorobenzene	mg/l	0.0164	0.00	0.02	82.0	65-119	L141005-02	WG140662
1,2-Dichloroethane	mg/l	0.0188	0.00	0.02	93.8	48-148	L141005-02	WG140662
1,2-Dichloropropane	mg/l	0.0193	0.00	0.02	96.7	66-122	L141005-02	WG140662
1,3,5-Trimethylbenzene	mg/l	0.0194	0.00	0.02	96.8	60-127	L141005-02	WG140662
1,3-Dichlorobenzene	mg/l	0.0186	0.00	0.02	92.8	62-122	L141005-02	WG140662
1,3-Dichloropropane	mg/l	0.0206	0.00	0.02	103.	77-121	L141005-02	WG140662
1,4-Dichlorobenzene	mg/l	0.0160	0.00	0.02	79.8	60-123	L141005-02	WG140662
2,2-Dichloropropane	mg/l	0.0193	0.00	0.02	96.4	40-148	L141005-02	WG140662
2-Butanone (MEK)	mg/l	0.107	0.00	0.1	107.	26-114	L141005-02	WG140662
2-Chloroethyl vinyl ether	mg/l	0.00	0.00	0.1	0.0	0-100	L141005-02	WG140662
2-Chlorotoluene	mg/l	0.0187	0.00	0.02	93.5	62-120	L141005-02	WG140662
4-Chlorotoluene	mg/l	0.0185	0.00	0.02	92.3	63-123	L141005-02	WG140662
4-Methyl-2-pentanone (MIBK)	mg/l	0.0871	0.00	0.1	87.1	56-133	L141005-02	WG140662
Acetone	mg/l	0.0960	0.00	0.1	96.0	13-145	L141005-02	WG140662
Acrolein	mg/l	0.221	0.00	0.1	221.	14-90	L141005-02	WG140662
Acrylonitrile	mg/l	0.107	0.00	0.1	107.	33-128	L141005-02	WG140662
Benzene	mg/l	0.0215	0.00	0.02	107.	55-130	L141005-02	WG140662
Bromobenzene	mg/l	0.0197	0.00	0.02	98.4	67-134	L141005-02	WG140662
Bromodichloromethane	mg/l	0.0183	0.00	0.02	91.5	57-126	L141005-02	WG140662
Bromoform	mg/l	0.0214	0.00	0.02	107.	52-130	L141005-02	WG140662
Bromomethane	mg/l	0.0119	0.00	0.02	59.5	17-150	L141005-02	WG140662
Carbon tetrachloride	mg/l	0.0187	0.00	0.02	93.7	42-141	L141005-02	WG140662
Chlorobenzene	mg/l	0.0195	0.00	0.02	97.7	66-125	L141005-02	WG140662
Chlorodibromomethane	mg/l	0.0193	0.00	0.02	96.4	58-123	L141005-02	WG140662
Chloroethane	mg/l	0.0170	0.00	0.02	85.0	29-131	L141005-02	WG140662
Chloroform	mg/l	0.0191	0.00	0.02	95.5	46-136	L141005-02	WG140662
Chloromethane	mg/l	0.0173	0.00	0.02	86.4	26-120	L141005-02	WG140662
cis-1,2-Dichloroethene	mg/l	0.0230	0.0062	0.02	83.9	59-133	L141005-02	WG140662
cis-1,3-Dichloropropene	mg/l	0.0171	0.00	0.02	85.3	77-132	L141005-02	WG140662
Di-isopropyl ether	mg/l	0.0233	0.00	0.02	117.	47-141	L141005-02	WG140662
Dibromomethane	mg/l	0.0176	0.00	0.02	87.9	64-119	L141005-02	WG140662
Dichlorodifluoromethane	mg/l	0.0133	0.00	0.02	66.4	13-113	L141005-02	WG140662
Ethylbenzene	mg/l	0.0198	0.00	0.02	98.9	61-123	L141005-02	WG140662
Hexachlorobutadiene	mg/l	0.0130	0.00	0.02	65.1	39-138	L141005-02	WG140662
Isopropylbenzene	mg/l	0.0172	0.00	0.02	85.8	56-120	L141005-02	WG140662
Methyl tert-butyl ether	mg/l	0.114	0.00	0.02	571.	43-140	L141005-02	WG140662
Methylene Chloride	mg/l	0.0205	0.00	0.02	103.	55-123	L141005-02	WG140662
n-Butylbenzene	mg/l	0.0153	0.00	0.02	76.4	43-139	L141005-02	WG140662
n-Propylbenzene	mg/l	0.0187	0.00	0.02	93.7	57-127	L141005-02	WG140662
Naphthalene	mg/l	0.0205	0.00	0.02	102.	39-122	L141005-02	WG140662
p-Isopropyltoluene	mg/l	0.0181	0.00	0.02	90.6	58-127	L141005-02	WG140662
sec-Butylbenzene	mg/l	0.0180	0.00	0.02	89.8	55-124	L141005-02	WG140662
Styrene	mg/l	0.0197	0.00	0.02	98.6	61-119	L141005-02	WG140662
tert-Butylbenzene	mg/l	0.0193	0.00	0.02	96.5	58-129	L141005-02	WG140662
Tetrachloroethene	mg/l	0.0194	0.00	0.02	96.9	49-144	L141005-02	WG140662
Toluene	mg/l	0.0166	0.00	0.02	83.1	59-123	L141005-02	WG140662
trans-1,2-Dichloroethene	mg/l	0.0198	0.00	0.02	99.1	53-145	L141005-02	WG140662
trans-1,3-Dichloropropene	mg/l	0.0159	0.00	0.02	79.4	69-125	L141005-02	WG140662
Trichloroethene	mg/l	0.0184	0.00	0.02	91.8	61-141	L141005-02	WG140662
Trichlorofluoromethane	mg/l	0.0144	0.00	0.02	72.2	24-113	L141005-02	WG140662
Vinyl chloride	mg/l	0.0175	0.0018	0.02	78.4	26-110	L141005-02	WG140662
Xylenes, Total	mg/l	0.0650	0.00	0.06	108.	64-119	L141005-02	WG140662
Iron, Dissolved	mg/l	11.9	11.0	1.13	82.3	75-125	L141005-02	WG140681



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L141005

Manganese, Dissolved	mg/l	7.70	6.70	1.13	88.6	75-125	L141005-02	WG140681
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Analyte	Units	Matrix Res	Spike Ref Res	TV	% Rec	Limit	Ref Samp	Batch
Sulfide	mg/l	0.960	0.00	1	96.0	80-120	L141005-01	WG140829
DOC	mg/l	20.0	2.60	20	87.0	80-120	L141005-01	WG140996

Analyte	Units	Matrix Res	Spike Ref Res	Duplicate RPD	Limit	%Rec	Ref Samp	Batch
Nitrate	mg/l	4.76	4.74	0.271	20	94.7	L140643-21	WG140525
Nitrite	mg/l	4.75	4.72	0.544	20	95.0	L140643-21	WG140525
Sulfate	mg/l	48.3	48.2	0.151	20	96.6	L140643-21	WG140525
TOC (Total Organic Carbon)	mg/l	20.0	20.0	0.00	20	100.	L140971-01	WG140588
Iron	mg/l	1.09	1.05	3.37	20	96.2	L141005-01	WG140610
1,1,1,2-Tetrachloroethane	mg/l	0.0189	0.0210	10.3	16	94.5	L141005-02	WG140662
1,1,1-Trichloroethane	mg/l	0.0184	0.0183	0.546	28	91.9	L141005-02	WG140662
1,1,2,2-Tetrachloroethane	mg/l	0.0180	0.0211	15.7	10	90.1	L141005-02	WG140662
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/l	0.0180	0.0190	5.19	40	90.0	L141005-02	WG140662
1,1,2-Trichloroethane	mg/l	0.0170	0.0174	2.21	16	85.1	L141005-02	WG140662
1,1-Dichloroethane	mg/l	0.0193	0.0203	5.30	17	96.4	L141005-02	WG140662
1,1-Dichlorobenzene	mg/l	0.0202	0.0218	7.52	36	101.	L141005-02	WG140662
1,1-Dichloropropene	mg/l	0.0178	0.0187	4.87	33	89.2	L141005-02	WG140662
1,2,3-Trichlorobenzene	mg/l	0.0168	0.0155	8.00	17	83.8	L141005-02	WG140662
1,2,3-Trichloropropane	mg/l	0.0170	0.0192	12.0	13	85.1	L141005-02	WG140662
1,2,3-Trimethylbenzene	mg/l	0.0163	0.0163	0.245	20	81.5	L141005-02	WG140662
1,2,4-Trichlorobenzene	mg/l	0.0158	0.0151	4.15	25	78.8	L141005-02	WG140662
1,2,4-Trimethylbenzene	mg/l	0.0200	0.0220	9.58	29	99.9	L141005-02	WG140662
1,2-Dibromo-3-Chloropropane	mg/l	0.0171	0.0199	14.9	21	85.7	L141005-02	WG140662
1,2-Dibromoethane	mg/l	0.0179	0.0206	14.3	19	89.3	L141005-02	WG140662
1,2-Dichlorobenzene	mg/l	0.0164	0.0164	0.122	16	82.1	L141005-02	WG140662
1,2-Dichloroethane	mg/l	0.0183	0.0188	2.70	13	91.3	L141005-02	WG140662
1,2-Dichloropropane	mg/l	0.0191	0.0193	1.25	14	95.5	L141005-02	WG140662
1,3,5-Trimethylbenzene	mg/l	0.0180	0.0194	7.23	28	90.1	L141005-02	WG140662
1,3-Dichlorobenzene	mg/l	0.0173	0.0186	7.20	25	86.3	L141005-02	WG140662
1,3-Dichloropropane	mg/l	0.0179	0.0206	14.4	15	89.3	L141005-02	WG140662
1,4-Dichlorobenzene	mg/l	0.0164	0.0160	2.41	18	81.8	L141005-02	WG140662
2,2-Dichloropropane	mg/l	0.0188	0.0193	2.31	31	94.2	L141005-02	WG140662
2-Butanone (MEK)	mg/l	0.0934	0.107	13.2	10	93.4	L141005-02	WG140662
2-Chloroethyl vinyl ether	mg/l	0.00	0.00	0.00	25	0.00	L141005-02	WG140662
2-Chlorotoluene	mg/l	0.0170	0.0187	9.41	24	85.1	L141005-02	WG140662
4-Chlorotoluene	mg/l	0.0167	0.0185	9.83	22	83.7	L141005-02	WG140662
4-Methyl-2-pentanone (MIBK)	mg/l	0.0942	0.0871	7.79	12	94.2	L141005-02	WG140662
Acetone	mg/l	0.0826	0.0960	15.0	23	82.6	L141005-02	WG140662
Acrolein	mg/l	0.175	0.221	23.6	34	175.	L141005-02	WG140662
Acrylonitrile	mg/l	0.0930	0.107	13.8	13	93.0	L141005-02	WG140662
Benzene	mg/l	0.0203	0.0215	5.41	20	102.	L141005-02	WG140662
Bromobenzene	mg/l	0.0183	0.0197	7.05	22	91.7	L141005-02	WG140662
Bromodichloromethane	mg/l	0.0181	0.0183	1.04	13	90.6	L141005-02	WG140662
Bromoform	mg/l	0.0191	0.0214	11.6	18	95.5	L141005-02	WG140662
Bromomethane	mg/l	0.0101	0.0119	15.9	20	50.7	L141005-02	WG140662
Carbon tetrachloride	mg/l	0.0185	0.0187	1.40	36	92.4	L141005-02	WG140662
Chlorobenzene	mg/l	0.0176	0.0195	10.5	21	88.0	L141005-02	WG140662
Chlorodibromomethane	mg/l	0.0169	0.0193	13.0	17	84.6	L141005-02	WG140662
Chloroethane	mg/l	0.0152	0.0170	10.9	25	76.2	L141005-02	WG140662
Chloroform	mg/l	0.0185	0.0191	3.36	26	92.3	L141005-02	WG140662
Chloromethane	mg/l	0.0153	0.0173	12.4	31	76.3	L141005-02	WG140662
cis-1,2-Dichloroethene	mg/l	0.0205	0.0230	11.6	18	71.3	L141005-02	WG140662
cis-1,3-Dichloropropene	mg/l	0.0194	0.0171	12.8	17	97.0	L141005-02	WG140662



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L141005

Di-isopropyl ether	mg/l	0.0216	0.0233	7.65	13	108.	L141005-02	WG140662
Matrix Spike Duplicate								
Analyte	Units	MSD Res	Ref Res	RPD	Limit	%Rec	Ref Samp	Batch
Dibromomethane	mg/l	0.0186	0.0176	5.85	12	93.2	L141005-02	WG140662
Dichlorodifluoromethane	mg/l	0.0129	0.0133	3.29	28	64.3	L141005-02	WG140662
Ethylbenzene	mg/l	0.0175	0.0198	12.2	25	87.5	L141005-02	WG140662
Hexachlorobutadiene	mg/l	0.0141	0.0130	7.90	36	70.4	L141005-02	WG140662
Isopropylbenzene	mg/l	0.0158	0.0172	8.51	29	78.8	L141005-02	WG140662
Methyl tert-butyl ether	mg/l	0.102	0.114	11.5	16	509.	L141005-02	WG140662
Methylene Chloride	mg/l	0.0194	0.0205	5.55	16	97.2	L141005-02	WG140662
n-Butylbenzene	mg/l	0.0155	0.0153	1.24	30	77.4	L141005-02	WG140662
n-Propylbenzene	mg/l	0.0169	0.0187	10.3	30	84.5	L141005-02	WG140662
Naphthalene	mg/l	0.0211	0.0205	3.17	39	106.	L141005-02	WG140662
p-Isopropyltoluene	mg/l	0.0171	0.0181	6.08	36	85.3	L141005-02	WG140662
sec-Butylbenzene	mg/l	0.0165	0.0180	8.29	32	82.7	L141005-02	WG140662
Styrene	mg/l	0.0175	0.0197	12.0	21	87.4	L141005-02	WG140662
tert-Butylbenzene	mg/l	0.0181	0.0193	6.37	30	90.5	L141005-02	WG140662
Tetrachloroethene	mg/l	0.0177	0.0194	9.01	32	88.6	L141005-02	WG140662
Toluene	mg/l	0.0190	0.0166	13.4	17	95.0	L141005-02	WG140662
trans-1,2-Dichloroethene	mg/l	0.0187	0.0198	5.98	27	93.3	L141005-02	WG140662
trans-1,3-Dichloropropene	mg/l	0.0180	0.0159	12.8	16	90.2	L141005-02	WG140662
Trichloroethene	mg/l	0.0181	0.0184	1.43	25	90.5	L141005-02	WG140662
Trichlorofluoromethane	mg/l	0.0140	0.0144	3.02	41	70.1	L141005-02	WG140662
Vinyl chloride	mg/l	0.0160	0.0175	8.90	36	71.0	L141005-02	WG140662
Xylenes, Total	mg/l	0.0582	0.0650	11.1	21	96.9	L141005-02	WG140662
Iron, Dissolved	mg/l	11.9	11.9	0.513	20	76.9	L141005-02	WG140681
Manganese, Dissolved	mg/l	7.69	7.70	0.143	20	87.6	L141005-02	WG140681
Sulfide	mg/l	0.990	0.960	3.08	20	99.0	L141005-01	WG140829
DOC	mg/l	20.0	20.0	0.00	20	87.0	L141005-01	WG140996

Batch number / Run number / Sample number cross reference

WG140657: R184316: L141005-01 02 03
WG140619: R184323: L141005-01 02 03
WG140610: R184336: L141005-01 02 03
WG140588: R184349: L141005-01 02 03
WG140525: R184382: L141005-01 02 03
WG140662: R184421: L141005-01 02 03
WG140681: R184440: L141005-01 02 03
WG140829: R184444: L141005-01 02 03
WG140706: R184491: L141005-01 02 03
WG140996: R184578: L141005-01 02 03

* See Attachment B of standard report for list of qualifiers.
* Calculations are performed prior to rounding of reported values .



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Quality Assurance Report
Level II

L141005

January 20, 2004

ESC Level 2 Data Package

The data package includes a summary of the analytic results of the quality control samples required by the SW-846 or CWA methods. The quality control samples include a method blank, a laboratory control sample, and the matrix spike/matrix spike duplicate analysis. If a target parameter is outside the method limits, every sample that is effected is flagged with the appropriate qualifier in Appendix B of the analytic report.

Method Blank - an aliquot of reagent water carried through the entire analytic process. The method blank results indicate if any possible contamination exposure during the sample handling, digestion or extraction process, and analysis. Concentrations of target analytes above the reporting limit in the method blank are qualified with the "B" qualifier.

Laboratory Control Sample - is a sample of known concentration that is carried through the digestion/extraction and analysis process. The percent recovery, expressed as a percentage of the theoretical concentration, has statistical control limits indicating that the analytic process is "in control". If a target analyte is outside the control limits for the laboratory control sample or any other control sample, the parameter is flagged with a "J4" qualifier for all effected samples.

Matrix Spike and Matrix Spike Duplicate - is two aliquots of an environmental sample that is spiked with known concentrations of target analytes. The percent recovery of the target analytes also has statistical control limits. If any recoveries that are outside the method control limits, the sample that was selected for matrix spike/matrix spike duplicate analysis is flagged with either a "J5" or a "J6". The relative percent difference (%RPD) between the matrix spike and the matrix spike duplicate recoveries is all calculated. If the RPD is above the method limit, the effected samples are flagged with a "J3" qualifier.